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**Cover Photograph:**

**Pond surrounded by blooming Redbuds marks the heart of campus at The University of West Alabama, Livingston, AL, site of the 79th Annual Meeting of the Alabama Academy of Science, March 27-30, 2002.**



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**THE JOURNAL  
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## ABSTRACTS

Papers presented at the 79<sup>th</sup> Annual Meeting  
University of West Alabama  
Livingston, Alabama  
March 27-30, 2002

## BIOLOGICAL SCIENCES

### **THE EFFECTS OF CHRONIC INORGANIC AND ORGANIC PHOSPHATE EXPOSURE ON ASPECTS OF MUSCLE PHYSIOLOGY OF THE NEARSHORE SEA URCHIN *Lytechinus variegatus* (ECHINODERMATA: ECHINOIDEA).**

S. Anne Böttger\*, David W. Kraus and James B. McClintock, Department of Biology, The University of Alabama at Birmingham, 1300 University Boulevard, Birmingham, AL, 35294-1170.

The common nearshore sea urchin *Lytechinus variegatus* is exposed to phosphate pollutants in its natural environment. Sea urchins were collected in April, 200 from Saint Joseph Bay in the northern Gulf of Mexico. Individuals were divided into a control (artificial seawater), seawater containing three concentrations of inorganic (sodium phosphate), or three concentrations of organic (triethyl phosphate) phosphate. Individuals were thus maintained for an 8-week period, dissected and the Aristotle's lantern protractor muscles extracted. Each muscle was attached to a strain gage, stimulated electrically, and muscle contractions recorded. Maximum force of muscle contraction (N force/ mm cross-sectional area), and rates of muscle contraction and relaxation (N force/ mm cross-sectional area/ sec) decreased with chronic exposure to increasing concentrations of organic phosphate. Chronic exposure to inorganic phosphates elicited no response except at the highest concentration, where the maximum force of muscular contraction increased compared to controls. Acetyl cholinesterase activity, measured in both a static enzyme assay and by vesicular staining, displayed concentration-dependent declines of activity in individuals maintained in organic phosphate for four weeks. The activity of AChE was not adversely affected by exposure to inorganic phosphate or seawater controls over the experimental time period. These findings indicate that shallow-water populations of *Lytechinus variegatus* subjected to organic phosphate pollutants may display impaired muscular activity that is potentially related to the inhibition of the muscle relaxant enzyme AChE, and subsequently muscular overstimulation and fatigue.

APPLICATION OF SUBTRACTION HYBRIDIZATION APPROACH TO IDENTIFICATION OF GENETIC ELEMENTS IN PANDEMIC STRAINS OF *VIBRIO PARAHAEMOLYTICUS* O3:K6 SEROTYPE. Lisa Ann Blankinship and Asim Bej, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

*Vibrio parahaemolyticus* serotype O3:K6, a Gram negative microorganism that causes gastroenteritis in humans, emerged in 1996 as an epidemic strain in Calcutta, India and spread throughout Southeast Asia and North America. This study was conducted to identify genetic differences between *V. parahaemolyticus* nonpandemic pre-1996 strains and pandemic post-1996 strains and to identify novel genetic elements found in pandemic O3:K6 by subtractive hybridization methods. In this procedure, "Tester" DNA (pandemic O3:K6) was restricted with *RsaI* and split into two samples with different adaptors ligated onto each sample. "Driver" DNA (nonpandemic O3:K6) was similarly digested with *RsaI* before adding in excess to each Tester sample. Samples were allowed to hybridize overnight followed by mixing of the two samples and an additional round of hybridization was conducted. PCR was performed on secondary hybridization products to selectively amplify only those fragments that contained two different adaptors, which represented unique Tester sequences. PCR products were cloned onto a Topo™ TA plasmid vector, sequenced, and made into probes to test Driver, Tester, and non O3:K6 *V. parahaemolyticus* genomic DNA in a Dot Blot hybridization. Two fragments were found to be unique to *V. parahaemolyticus* pandemic strain, and are currently being investigated to determine the possible origin of this pandemic strain and their use as targets for a PCR-based and/or gene probe-based specific rapid detection of this pathogen in marine water and shellfish.

ANTIMICROBIAL ACTIVITIES OF BACTERIAL ISOLATES FROM SALINE ENVIRONMENTS. Maria Martin and Donald Salter, University of West Alabama.

Our laboratory has cultured a significant number of bacterial isolates from three different aquatic saline environments: an inland salt spring near Jackson, AL, an estuarine environment near Pensacola Beach, FL, and from the Gulf off Pensacola Beach, FL. We have previously reported the inorganic requirements and biological activities of some of these isolates. We have now screened a significant number of bacterial isolates from these diverse saline environments for antimicrobial activity and growth competition against known Gram-positive and Gram-negative bacterial species. Approximately twenty percent of the isolates appeared to produce measurable antimicrobial activity as assayed using a modified Kirby-Bauer technique. Further, many other isolates appear to directly compete with both Gram-positive and Gram-negative bacterial species for growth on the agar plates. These bacterial isolates have been re-tested against these and additional Gram-positive and Gram-negative bacteria to confirm and extend the initial results. Those isolates producing significant antimicrobial activity and growth competition will be used in future studies that will include optimizing antimicrobial production, determining antimicrobial stability, and developing a quantitative method for measuring growth competition.



ARCHAEBACTERIA AND EUBACTERIA CONCENTRATIONS IN AQUATIC AREAS OF THREE DIVERSE SALINE ENVIRONMENTS. Mandy Cook\*, Donald Salter\*\*, and Michael Lemke\*. \*University of Illinois at Springfield and \*\*University of West Alabama.

This study examines microorganism abundance in an extreme saline aquatic ecosystem and compares the findings to abundances in other less saline aquatic systems. The study objectives were to determine the total number of bacteria and number of microorganisms in the Domains Archaea and Bacteria in these saline samples. Water samples (n=3) were collected from seven sites in Alabama and Florida between June - September 2000: A Saline seep (48ppt), bubbling springs (45 ppt), and lake-saline river inlet (10 ppt) from the Salt Springs area near Jackson, AL, two sites of a freshwater stream (Up-stream 3 ppt; Down-stream 0 ppt) near the Salt Springs area, and an estuarine environment (26 ppt) and the Gulf waters (37 ppt) near Pensacola Beach, FL. Total bacteria numbers, determined by the DAPI method, showed highest abundance in the estuary sample ( $3.01 \times 10^6/\text{ml}$ ) as compared to the Salt Springs samples ( $1.99 \times 10^5/\text{ml}$ ). In-situ whole-cell hybridization with domain-specific fluorescent probes was used to determine abundance of prokaryotes in each Domain. Both Domains had highest abundance at the estuary site (eubacteria at  $6.51 \times 10^5/\text{ml}$ ; archaeabacteria at  $3.72 \times 10^4/\text{ml}$ ) as compared to the Salt Springs (eubacteria at  $1.19 \times 10^4/\text{ml}$ ; archaeabacteria at  $1.73 \times 10^3/\text{ml}$ ). Active prokaryotes, (calculated as the number of hybridized cells/number of DAPI-stained cells) showed that three sites (estuary, sea shore, and the saline seep) had the highest cellular activity. These results show that, even though the most abundant site of study was the estuary, the most cellular activity is occurring in the three separate systems.

BACTERIAL SOURCE TRACKING IN SURFACE WATERS. Kim Autrey, Brianna Stansbury, and Brian S. Burnes, Dept. of Biology, Judson College, Marion, AL 36756.

Antibiotic resistance analysis (ARA) was used to determine sources of fecal coliform pollution in Dry Creek in south Perry County, AL. The Dry Creek watershed encompasses 5,329 acres and is predominantly agricultural with little urban or developed area. A library of antibiotic resistance profiles based on 9 drugs was developed for 1,152 fecal coliform isolates from human, cattle, and deer sources. Discriminant functions were developed to classify each isolate as human, cattle or deer in origin. Correct classification rates were greater than 80% for each isolate. Antibiotic resistance profiles were then determined for 768 isolates from Dry Creek, collected during high or low water levels during January 2002, and compared to the known sources using discriminant analysis. Human, cattle, and deer profiles were found in each sample, however, the isolates classified as human predominated in both samples. The results indicate fecal coliforms from both human and cattle sources contribute to fecal pollution in the Dry Creek watershed.

CELL SIGNALING PATHWAYS FOR ECDYSTEROIDOGENESIS IN BLUE CRAB (*CALLINECTES SAPIDUS*) Y-ORGANS. Deug Woo Han and R. Douglas Watson. Department of Biology, University of Alabama at Birmingham, AL 35294.

Synthesis of ecdysteroid molting hormones by crustacean Y-organs is regulated (negatively) by a neuropeptide, molt-inhibiting hormone (MIH). The underlying mechanisms that link MIH receptor occupancy to the subsequent suppression of ecdysteroidogenesis in Y-organs remain unresolved. Several lines of evidence indicate the effect of MIH is mediated by a rise in the intracellular level of one or more cyclic nucleotide second messenger (cAMP, cGMP, or both). We report here the results of experiments conducted *in vitro* to assess the possible roles of these key second messengers in cell signaling pathways for ecdysteroidogenesis in Y-organs of the blue crab, *Callinectes sapidus*. A Gs-protein activator (cholera toxin), cAMP analogs (dibutyryl cAMP or 8-bromo-cAMP), and forskolin (an adenylyl cyclase activator) each had no effect on ecdysteroid synthesis. By contrast, a cGMP analog (8-bromo-cGMP) dose-dependently suppressed ecdysteroid synthesis by Y-organs *in vitro*. The maximal level of suppression (~50%) was similar to that observed when blue crab Y-organs were incubated with eyestalk extract containing native MIH. The results suggest that cGMP is likely to be a physiologically relevant second messenger in regulation of ecdysteroid synthesis by Y-organs of *C. sapidus*, and that activation of the MIH receptor may be linked to regulation of guanylyl cyclase activity. Supported by MS/AL Sea Grant and the UAB Graduate School.

CHARACTERIZING A WATERSHED SEDIMENT EROSION POTENTIAL USING GIS TECHNOLOGY. Janna Owens, Ken Marion and Robert Angus. UAB, Dept. of Biology, Birmingham, AL 35294. Melinda Lator, Civil and Environmental Engineering, UAB. Eric Meyer and Steve McKinney, SWMA, Inc.

To be effective, monitoring programs for nonpoint source contaminants must include the ability to identify the causes of water quality impairment within the watershed. Our study objective was to devise a water quality assessment protocol to evaluate sedimentation effects that incorporated habitat assessment and biological sampling with a sediment-erosion potential model based on geographical information system (GIS) data. The Cahaba River and its tributaries were investigated for water quality conditions and excessive sedimentation by utilizing benthic macroinvertebrate community structures as possible indicators. Various aspects of the biological status of the benthic community were then analyzed with a series of metrics. To quantify the upstream watershed sedimentation characteristics above the sample sites, a soil erosion potential model was constructed using Geographic Information Systems (GIS) and remote sensing technologies. The cartographic model consisted of selected data layers for the study area, including soil types, multispectral satellite imagery, parcel level land use, and a digital elevation model. A Sedimentation Potential Index (SPI) was calculated for each watershed and correlated with site habitat conditions, sediment depths and upstream watershed land usage. Strong associations were evident between the SPI scores and specific metrics that have previously been shown to be sensitive to sedimentation impacts, such as the EPT (Ephemeroptera, Plecoptera, Trichoptera), Sorenson Similarity and Hilsenhoff Biotic Indices.

DIATOM ASSEMBLAGES FROM A SALINE SPRING SYSTEM, CLARKE COUNTY, ALABAMA. Lisa A. Muellner and Roland R. Dute, Department of Biological Sciences, Auburn University, Auburn, AL 36849.

Diatoms (Bacillariophyceae) have recently gained the attention of ecologists and paleolimnologists as valuable indicators of water quality and environmental change. The Fred T. Stimpson Wildlife Sanctuary provides a unique environment in which to study the influence of environmental factors on diatom communities. The Sanctuary, located in Clarke County, Alabama, is comprised of a system of natural salt springs that flow into freshwater streams, giving rise to a salinity gradient. Preliminary data suggest that salinity measured at various stations along the gradient is stable over time and ranges from 0 to 48 ppt. Spring flooding, however, might result temporarily in a more homogenous, less saline environment throughout much of the system. Sediment samples taken from stations along the gradient consist of unique benthic diatom communities with varying levels of taxonomic diversity. Dominant taxa include *Achnanthes lanceolata* de Brébisson ex Kützing (freshwater), *Fragilaria pinnata* var. *intercedens* (Grunow) Hustedt (14-17 ppt. salinity), and *Amphora coffeaeformis* (Agardh) Kützing (40-48 ppt. salinity). At present, 94 diatom species have been identified. Ongoing research is expected to clarify relationships between diatom communities within the system and environmental factors such as light, temperature, nutrients, and pH, as well as salinity ranges and salinity fluctuations. Funding is provided through the Auburn University Dean's Research Initiative, Auburn University Graduate Research Award, and the Lands Division of the Alabama Department of Conservation and Natural Resources.

THE EFFECT OF TEMPERATURE ON CONSUMPTION AND GROWTH IN THE SEA URCHIN *LYTECHINUS VARIEGATUS*. Scott C. Hofer, Stephen A. Watts, Dept. of Biology, Univ. of Ala. at Birmingham, AL 35294-1170. John M. Lawrence, Univ. S. Florida, Tampa, FL 33620.

*Lytechinus variegatus* are common in near-shore marine communities throughout much of the Caribbean and Gulf of Mexico regions. Adult individuals (ca. 39 to 45mm diameter) collected at St. Joseph Bay, FL (22 C) were held at 16, 22 or 28 C for 8 weeks and fed a prepared diet *ad libitum*. At the time of the initial collection and at the end of the study urchins were dissected for component analysis. Overall consumption was highest in those exposed to 22 C. Urchins exposed to 16 C showed partial acclimation (feeding rate) within one month. Dry matter absorption efficiency was 66, 67, and 76% at 16, 22 and 28 C. Individuals exposed to 22 C exhibited the highest total weight gain (production) and increase in diameter. Total production efficiencies (g dry mass produced/g dry mass absorbed) were inversely proportional to the exposure temperature, ranging from 27 to 42 %, indicating that the energy requirement for maintenance and/or production increases with temperature. Gonad production was significantly higher in urchins held at 22 C. Gonad production efficiencies were also inversely proportional to temperature and ranged from 9 to 15%. Interestingly, gut mass was 2-fold larger in those exposed to 16 C than at 28 C. We hypothesize that the storage capacity of the gut is increased at low temperature. Alternatively, a larger gut may increase digestive capacity to compensate for the effects of reduced temperature on the rate of digestion. The temperature of maximal growth (22 C) is also the median temperature to which the urchins are exposed in the field annually.

THE EFFECTS OF EPICUTICULAR WAX ON THE RATE OF WATER LOSS OF *SORGHUM BICOLOR*. Mijitaba Hamissou, Department of Biology, Jacksonville State University, Al 36265 and Dale Weibel, Oklahoma State University, Ok 74078

Sorghum leaves are normally covered with an epicuticular wax. The amount of wax ranges from a heavy covering or "bloom" to light covering or "sparse bloom". The condition where there is no visible wax covering is termed "bloomless." Wax prevents desiccation, minimizes mechanical damage, and protects against excessive ultra-violet radiation. A reduction of solar energy load on the plant through increased reflectance, an avoidance of reduced water potential, and maintenance of a more complete stomatal control over transpiration manifest the contribution of wax to the prevention of water loss. Physiological and anatomical features of the plant govern plant water loss. The objectives of this study are (1) to determine the difference in stomatal conductance among the bloom, the sparse-bloom, and the bloomless, (2) and to compare the rate of water loss between the flag leaf and the third leaf down.

Field and greenhouse experiments were conducted to determine the rate of water loss of three near-isogenic lines of sorghum variety of ROKY62 and ROKY78. Boot stage, stomatal conductance, photosynthetic and transpiration rate were measured on both flag leaf and the third leaf down. Leaf water potential was measured using thermocouple psychrometers.

Our data indicated that epicuticular wax plays an important role in protecting sorghum plants against stomatal water loss. We also found that bloomless sorghum plants had more negative water potential and lower photosynthetic rate than the other lines.

EFFECTS OF PHLOXINE B ON POPULATION GROWTH AND RESPIRATION RATES IN *TETRAHYMENA SPP*. Christa Collins, Charles Olander, Mark Meade, H. Blake Otwell, Dept. of Physical and Earth Sciences, and Dept. of Biology, Jacksonville State Univ., Jacksonville State Univ., Jacksonville, AL 36265.

Phloxine B is a halogenated photoactive xanthene dye that is FDA approved for use in human cosmetics and drugs. Research shows Phloxine B to be a safe and effective pesticide for the treatment of various insects. Light activates the ingested dye inside the insects, where it forms a potent oxidizing agent that attacks their tissues. It is not contact toxic. Comparison of the toxicity and metabolic effects of the light independent and light dependent Phloxine B on *Tetrahymena pyriformis* are currently being conducted. Our data indicate that Phloxine B at 10ppm, 1ppm, 0.1ppm is detrimental to the growth and that Phloxine B at 10ppm has a significant effect on the oxygen consumption of *Tetrahymena*.

*ERYSIPELOTHRIX* IN A BOTTLENOSE DOLPHIN. Gerald T. Regan 4000 Dauphin Street, Mobile, AL 36608.

This gram-positive bacillus has been found in bottlenose dolphins elsewhere in their geographic range, but its presence in Alabama coastal waters is now documented. The beach-cast specimen appeared on the Gulf of Mexico side of Dauphin Island on March 23, 2001. The freshly dead female had a total length of 218 cm and no external parasites, lesions or other signs of traumatic death. The usual protocol for the necropsy of marine mammals in Alabama was followed, excepting that a newly acquired form of liquefied protectant was used on the right-handed prosector's hands instead of latex gloves. The prosector had no contact with any other kind of specimen for several days prior to this necropsy. On the morning after the completion of the necropsy, two small, circular, inflamed areas appeared on the left hand of the prosector, one on the nail side of the terminal knuckle of the second finger and one at the base of the second finger and part way to the third finger. The thumb is the first finger here. Throughout that same day, the inflamed areas widened and swelled and pain set in. On the second day after the completion of the necropsy the prosector was hospitalized, laboratory tests were performed on fluid from one of the inflamed areas, and intravenous antibiotics were administered until the next morning, when the inflamed areas were no longer growing. The hospital laboratory found that the infection was caused by *Erysipelothrix rhusiopathiae*. In this form, evidence appeared for infection of the dolphin itself by the same bacteria. The help of C. Adrien Bodet, III, Patrick E. Nolan, and Stephen G. Alsip is gratefully acknowledged.

AN EVALUATION OF AGONISTIC BEHAVIORS OF SEVEN SPECIES OF *CANTHIGASTER* FISH AS A MECHANISM TO EVALUATE PHYLOGENETIC INTERRELATIONSHIPS. Yusheng Huang, Dept. of Biology, Univ. of Ala. At Birmingham, Birmingham, AL 35294. Hin-kiu Mok, Inst. of Marine Biology, National Sun Yat-Sen Univ., Kaohsiung 804, Taiwan (R. O. C.)

Many studies, including those with fishes, reptiles, rodents and birds, have evaluated phylogenetic relationships by using behavioral traits. Agonistic behaviors of seven species of tropical *Canthigaster* fish (*C. amboinensis*, *C. bennetti*, *C. compressus*, *C. coronata*, *C. janthinoptera*, *C. solandri*, and *C. valentini*) were analyzed by using cladistic methods to construct a consensus phylogenetic tree. Eleven agonistic behavioral patterns were recognized in the behavioral sequences of these seven fish species. While the degree of aggressiveness varied within a species (for example, female individuals of *C. valentini* were more aggressive than male individuals), intraspecific variation in patterns of agonistic behaviors was very low. This consistency of agonistic behaviors within a species facilitated the construction of a phylogenetic tree. On the basis of behavioral characters, the tree was comprised of two monophyletic groups. One group consisted of *C. bennetti*, *C. solandri*, *C. Coronata*, *C. valentini* and *C. compressus* and the other group consisted of *C. valentine* and *C. compressus*. On the basis of the proposed phylogeny, it appears that both behavioral repertoire and the complexity of the stereotypic behavior increase over evolutionary time.

AN EXAMINATION OF THE EFFECTS OF QUANTITATIVE AND QUALITATIVE DIFFERENCES IN FOOD AVAILABILITY ON REGENERATION IN PLANKTOTROPHIC LARVAE OF THE SEA STAR *PISASTER OCHRACEUS*.

Minako S. Vickery and James B. McClintock, Department of Biology, The University of Alabama at Birmingham, Birmingham, Alabama 35294-1170.

The role of food quantity and quality on regeneration in planktotrophic larvae of the sea star *Pisaster ochraceus* was examined. Surgically bisected late bipinnaria/early brachiolaria larvae were either starved, fed three concentrations of monospecific diets of the phytoplankton *Chaetoceros calcitrans*, *Dunaliella tertiolecta*, or *Isochrysis galbana*, or fed three concentrations of mixed diets comprised of equal numbers of cells of the three phytoplankton species over a 20-day experimental period. Control non-bisected larvae were fed the highest concentration of mixed phytoplankton. Regeneration occurred regardless of a complete lack of food or differences in food concentrations or food mixtures. Anterior portions of surgically bisected larvae starved or maintained on low or medium concentrations of single or mixed diets generally showed no growth or decreased in length over the experimental period. In contrast, while posterior portions of surgically bisected larvae starved or fed the lowest concentration of phytoplankton did not grow, those fed medium or high levels of single or mixed diets attained sizes equivalent to non-bisected fed control larvae, and also grew larger than posterior portions starved or fed low concentrations of food. These patterns of shrinkage or growth are likely related to the retention of a digestive system in the posterior portion of larvae post-bisection, whereas anterior portions required at least one week for regeneration of a functional gut. These results suggest regeneration occurs in damaged larvae in the natural environment even under conditions of food limitation.

FEMALE-BIASED SEX RATIO IN JUVENILE KEMP'S RIDLEY SEA TURTLES CAPTURED NEAR CEDAR KEYS, FL. Alyssa Geis, Dept. of Biology, Univ. of AL-Birmingham, Birmingham, AL 35294. Jaime Barichivich, U.S.G.S. Gainesville, FL 32653. and Thane Wibbels, Dept. of Biology, Univ. of AL-Birmingham, Birmingham, AL 35294.

The Kemp's ridley sea turtle, *Lepidochelys kempi*, is the most endangered sea turtle in the world. It possesses temperature-dependent sex determination (TSD), where the incubation temperature of the egg determines the sex of the hatchling. Past studies have suggested that TSD has the potential of producing highly biased sex ratios, which may not be advantageous to the recovery of endangered sea turtle populations. In that respect, it is important to monitor sex ratios within sea turtle populations. However, determining the sex of juvenile sea turtles is difficult, due to the fact that they lack the secondary sex characteristics commonly used to identify sex in adult turtles. In this study, a testosterone radioimmunoassay (RIA) was validated and used to predict the sex of juvenile Kemp's ridleys that were captured near Cedar Keys, Florida. The results show a significant female bias (3.7:1, female: male) currently exists in this group of juvenile Kemp's ridleys. The biased sex ratio predicted in the current study exemplifies the need to monitor sex ratios in sea turtle populations. Such information is a prerequisite to the development of an effective management strategy for endangered populations.

The Female Mosquitofish Anal Fin as a Biomarker for Androgen Exposure: a Dose-Response Study Comparing Characteristics of Fin Morphology and Measures of Reproductive Fitness. Jason P. Stanko, R. Douglas Watson, and Robert A. Angus, Dept. of Biology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

# Abstract

The anal fin rays of female mosquitofish can be induced to form a normally male-limited trait (gonopodium) if exposed to androgens. This external morphological trait can be used as a sensitive biomarker of environmental androgen exposure. This study characterized the dose-response relationship between androgen exposure and female anal fin masculinization and, and correlated changes in the biomarker with effects on gonad development and vitellogenesis. Female *Gambusia affinis* were masculinized through dietary administration of four concentrations of 17 $\alpha$ -methyltestosterone over a six-week period. Significant changes in fin ray morphology, an indicator of masculinization, occurred at the two higher dose levels. The mean gonadosomatic index value, however, did not change significantly until the highest treatment dose. A similar pattern was observed in vitellogenin expression. Histological analysis of ovarian sections from females treated with the highest dose revealed a decrease in total ovarian area due to a reduction in the number and frequency of late-stage vitellogenic follicles. This study demonstrates that the anal fin of female mosquitofish is a sensitive biomarker for environmental androgens. The mosquitofish anal fin may be used as a gauge of environmental androgen exposure in field studies and to identify exposed populations before effects on reproductive fitness become important. This work supported by EPA Grant R826130-01-0.

FLOWER ANATOMY AND MORPHOLOGY OF *CYRILLA RACEMIFLORA*. Roland R. Dute, Debbie R. Folkerts, Auburn Univ. 36849, James E. Watkins, Univ. of Florida, Milam E. Saxon and Heather A. Pritchard, Auburn University.

*Cyrilla racemiflora* is a typical component of the wetlands ecosystem in the Southeast. During our study of its pollination biology, the need for a thorough study of *Cyrilla*'s flower anatomy became evident. This was accomplished using light and scanning electron microscopy. At flowering, the pollen receptive organ (the stigma) is of the "wet" type with lipids on the surface. Lipid material is also manufactured in the stigmatoid tissue within the style—the identical pathway followed by growing pollen tubes. After flowering, petals and stamens abscise, but sepals remain. The sepals have stomates, and it is thought that the openings provide gas exchange for photosynthesis to support the enlarging fruit. At anthesis (flowering) the ovary is surrounded by a bright green belt thought to be a nectary. Sugar is probably manufactured at the site or brought in by vascular tissue. Nectar is then secreted through open stomates. The adaxial surfaces of the flower petals are thickened. While these sites might represent additional nectarics, there is no convincing evidence to support this hypothesis. Pollen grains, formed within the anthers, are two-celled at the time of their release. Calcium crystals are associated with the sites of pollen release from the anthers. This feature might represent a method of sequestering calcium from degrading anther walls prior to pollen release. Present studies of this species are focused on pollination biology and effectiveness of cross versus self-pollination.

FUNGAL GROWTH AND HOST RESPONSE ASSOCIATED WITH AMBROSIA BEETLE ATTACK ON *CERCIS CANADENSIS*. Roland R. Dute, Michael E. Miller, Auburn Univ. and the Alabama Agricultural Experiment Station, Micheal A. Davis, University of Southern Mississippi, Floyd M. Woods and Kathy S. McLean, Auburn Univ. and the Alabama Agricultural Experiment Station

Micro-organisms introduced by Asian ambrosia beetles (*Xylosandrus crassiusculus*) into redbud trees (*Cercis canadensis*) cause wilting and death of the host and economic losses to nursery owners. Female beetles bore into tree trunks in the spring. Investigation of the tunnels shows the presence of both bacteria and fungi. The fungi infect the host wood, and their hyphae spread from the site of infection. Fungi grow from one host cell to another through perforations of the xylem vessels, through pit membranes connecting cells, and even directly through secondary cell walls. Microscopy indicates the hyphae to be surrounded by a sheath and to contain considerable amounts of stored food. Fungi, isolated and cultured from infected trees, consist of various genera from the Deuteromycetes/Aseomycetes. In particular, the genus *Ambrosiella* is always associated with infection. In response to invasion by beetles and fungi, the host parenchyma cells degrade their inner walls. The resulting gel moves into and blocks the water-conducting vessels. This mechanism might inhibit spread of the fungi. Studies are underway to identify the species of *Ambrosiella* and to re-infect healthy trees using fungal cultures. This project is funded by the Alabama Agricultural Experiment Station.

HOOP-TRAP SURVEY OF FRESHWATER FISH COMMUNITIES ALONG COASTAL ALABAMA. David H. Nelson, William M. Turner and T. Joshua Meyer, Dept. of Biological Sciences, Univ. of South Alabama, Mobile, AL 36688.

Hoop traps were deployed for four summers in freshwater habitats in the Mobile-Tensaw delta and along the major coastal Alabama rivers. In 1994, traps set out in the lower delta (north of Interstate 10) yielded 236 specimens of 13 species (684 trap days). In 1995, the middle delta yielded 718 specimens of 24 species (1806 trap days). In 1997, traps in the upper delta (north of Interstate 65) yielded 231 specimens of 21 species (779 trap days). In 1996, the major coastal rivers (from Mississippi to Florida) and the Mobile Bay causeway were trapped to reveal 249 specimens of 24 species (1151 trap days). A total of 1434 captures were made of 38 species of fishes (4420 total trap days). Six species of fishes accounted for 80.5% of the captures: largemouth bass (*Micropterus salmoides*) 21.6%, black crappie (*Pomoxis nigromaculatus*) 18.7%, spotted gar (*Lepisosteus oculatus*) 16.6%, smallmouth buffalo (*Ictobius bubalus*) 14.2%, southern flounder (*Paralichthys lethostigma*) 4.8%, and bluegill (*Lepomis macrochirus*) 4.6%. The bowfin (*Amia calva*) and the alligator gar (*Lepisosteus spatula*) occurred (2.3% and 2.0%, respectively) within both the delta and coastal rivers. The fresh water drum (*Aplodinotus grunniens*) occurred (1.7%) in the delta but not in coastal rivers. The introduced common carp (*Cyprinus carpio*) and grass carp (*Ctenopharyngodon idella*) accounted for 0.5% and 0.1% of total catches, respectively.



INFLUENCE OF WEATHER ON THE SEX RATIO OF HATCHLING HAWKSBILL SEA TURTLES INHABITING BUCK ISLAND REEF NATIONAL MONUMENT, U.S. VIRGIN ISLANDS. Jennifer M. Estes, Thane Wibbels, Dept. of Biology, Univ. of AL-Birmingham, Birmingham, AL 35294, Zandy Hillis-Starr, National Park Service, Christiansted, St. Croix 00820-1611, U.S. Virgin Islands, and Brendalee Phillips, U.S.G.S., Christiansted, St. Croix 00820-1611, U.S. Virgin Islands.

The hawksbill sea turtle, *Eretmochelys imbricata*, possesses temperature-dependent sex determination (TSD) in which the incubation temperature of the egg (during the approximate middle third of incubation) determines the sex of the hatchling. This form of sex determination has the potential of producing a wide variety of sex ratios. Hatchling sex ratios resulting from TSD are of conservation interest, since they can affect the recovery of endangered populations. Buck Island represents a major natural nesting beach in the Caribbean for endangered hawksbill sea turtles. The purpose of the current study was to estimate hatchling sex ratios of hawksbill sea turtles on Buck Island Reef during the 1997, 1998, and 1999 nesting seasons and further determine possible influence of weather on these sex ratios. Incubation temperatures were monitored in a total of 48 nests over the 1997-1999 nesting seasons. The average incubation temperature during the middle third of incubation was used as a predictor of the overall clutch sex ratio. The results suggest an overall female-bias during each of the nesting seasons. However, the results also suggest that some male-biased clutches were produced due to major tropical weather systems passing through the U.S. Virgin Islands.

MOLECULAR ANALYSIS OF ALUMINUM TOXICITY TO *ARABIDOPSIS THALIANA*. Heather Morefield, Tomiko Goodman, and Mijitaba Hamissou, Department of Biology, Jacksonville State University, AL 36265

Aluminum, (Al), is the most abundant metal on the earth's crust. Aluminum interferes with the uptake, transport, and use of other ions required for metabolic activities. Research has indicated that Al disrupts cellular calcium homeostasis, rapidly represses root elongation, and interacts with the cell wall, the plasma membrane, and the root symplasm. Al was also shown to inhibit DNA synthesis. It also affects the nutrient status of the root zones due to its competitive interaction with Mg. One solution to Al toxicity to plants is the development of transgenic plants. *Arabidopsis thaliana* is a small flowering plant widely used as a model organism in plant molecular biology. Member of the mustard (Brassicaceae) family, it is characterized by a small genome and a rapid life cycle making it ideal for biological studies. The objective of this study is to investigate the molecular responses of arabidopsis plants to Al toxicity, and to assess on its encapsulation in the plant body.

Arabidopsis seeds were planted in pots containing mixture of vermiculite and sand. Germinated plants were kept in a growth chamber, watered and fertilized for four weeks. Plants were deprived of water for four days then watered with different concentrations of Al solution. Samples of leaves were taken at different time intervals for protein extractions and analysis.

The data indicated that arabidopsis plants exposed to higher Al concentration repress several classes of cytoplasmic proteins and express new classes of protein in the range of 80-85 Kd.

MONOCLONAL ANTIBODIES AGAINST ECDYSONE-BINDING YOLK POLYPEPTIDE IN THE CRICKET, *ACHETA DOMESTICUS*. Jeremy W. Bishop, Barbara H. Estridge, and James T. Bradley, Department of Biological Sciences, Auburn University, AL 36849.

During vitellogenesis, the fat body of *Acheta domesticus* produces and secretes two multisubunit vitellogenins (VGs; 352 kDa and 357 kDa) into the hemolymph. These are taken up by vitellogenic oocytes via receptor-mediated endocytosis and become egg vitellins (VTs). The five yolk polypeptide (YP) subunits (50–186 kDa) comprising VG/VT undergo developmental stage-specific processing during embryogenesis. One of these (YPIII; 53 kDa) reacts with anti-ecdysone and is believed to carry the steroid hormone into the egg during vitellogenesis. Preparative SDS-PAGE and affinity chromatography (Seize-X, Pierce Biochem. Co.) were used to purify egg YPIII which was used as an antigen to inoculate mice for MAB production. Six MABs were obtained from single-cloned fused cell lines. Three MABs reacted only with YPIII in Western blots and two reacted with YPIII and YPIIb. IgG MABs and anti-ecdysone showed similar patterns of reactivity with YPs in developing eggs from oviposition through day 7 of embryogenesis. At this point, the reactivity between anti-ecdysone and YPIII decreases, suggesting that ecdysone, during this period is cleaved from YPIII. This is further supported by the reactivity between the IgG MABs against YPIII, which does not decrease until day 13 of embryogenesis. In addition to this, Western blotting shows slight decreases in molecular weight of YPIII when it is incorporated into the oocyte from the hemolymph. These and the four IgM MABs obtained will be valuable for examining the entry of ecdysone into developing oocytes and its biological significance during embryogenesis.

MORPHOMETRIC VARIATION IN BLUEGILL SUNFISH FROM LOTIC AND LENTIC ENVIRONMENTS IN SUMTER COUNTY, ALABAMA. Sarah Branson and John McCall. Dept. of Biological and Environmental Sciences, University of West Alabama, Livingston, AL 35470.

Current velocity can be expected to be a significant factor affecting the fitness of fish. For a fish species that is found in both stream and pond environments, morphometric variation might well be expected between populations in these respective habitats. Bluegill sunfish (*Lepomis macrochirus*) collected in lotic and lentic environments in Sumter County, Alabama, were examined for variation in body and fin dimensions. Similarly-sized bluegill were sampled from non-flowing habitats within the Alamuchee Creek drainage and from a flowing environment in Ponkobia Creek. Body and fin dimensions were measured and ratios developed to allow comparison of body and fin shape. Statistical analysis revealed that fin shape differed significantly between the two populations. Both pectoral and pelvic fins were relatively longer in bluegill collected in lotic environments. Differences existed, as well, in the shape of the dorsal, anal, and caudal fins.

NESTING ACTIVITY OF THE ALABAMA REDBELLY TURTLE (*PSEUDEMYS ALABAMENSIS*). David H. Nelson, William M. Turner and T. Joshua Meyer, Dept. of Biological Sciences, Univ. of South Alabama, Mobile, AL 36688.

A study of nesting activity in the Alabama redbelly turtle was conducted in the vicinity of the Mobile Bay Causeway during the summer of 2001. Vegetative analysis of 47 depredated nests that turtles may prefer sites having some vegetation (when compared to unvegetated or heavily-vegetated areas). Nests were laid from 29 May to 7 August; hatchlings emerged from 3 September to 3 November. Clutch sizes for 16 nests ranged from 7 to 15 eggs ( $\bar{x}=10.8$ ). Developmental periods ranged from 69 to 117 days ( $\bar{x}=92.3$ ). The numbers of hatchlings from each of 16 nests ranged from 0 to 15 ( $\bar{x}=8.3$ ). The numbers of undeveloped eggs ranged from 0 to 14 eggs per nest ( $\bar{x}=8.0$ ). Virtually all hatchlings manifested mandibular cusps, eyebars and reddish plastrons (with vermiculations). Measurements of 91 hatchlings (from 12 clutches) disclosed a  $\bar{x}$  carapace length of 38.7mm, a  $\bar{x}$  carapace width of 38.7mm, a  $\bar{x}$  plastron width of 36.1mm, a  $\bar{x}$  tail length of 13.3mm and a  $\bar{x}$  wet body weight of 11.4 grams. Nest predation by raccoons, fish crows, and boat-tailed grackles was very high. Predator-excluder covers were used to protect eggs until they successfully completed development.

PATTERN OF STEROIDOGENIC FACTOR-1 EXPRESSION IN THE RED-EARED POND SLIDER TURTLE. Chris Murdock and Thane Wibbels, Dept. of Biology, U of Ala.-Birmingham, Birmingham, AL 35294.

A variety of reptiles possess temperature-dependent sex determination (TSD). The incubation temperature during the approximate middle-third of incubation, known as the thermosensitive period (TSP), determines the sex of the developing embryo. Studies have suggested that estrogen production during the TSP may control female sex determination. Therefore, the production of transcription factors or enzymes related to estrogen synthesis could represent temperature-sensitive elements. Steroidogenic factor-1 (SF1) represents a transcription factor of interest since it regulates the expression of various steroidogenic enzymes (e.g., P450 hydroxylase enzymes). The reported study utilized a quantitative competitive RT-PCR for measuring SF1 mRNA levels in the adrenal-kidney-gonad complexes of developing red-eared pond slider turtle embryos, at both male- and female-producing incubation temperatures. Results from these quantitative competitive RT-PCRs indicated that the pattern of SF1 expression was almost identical, throughout development, between embryos incubated at male- and female-producing temperatures. Only at stage 19 (a stage corresponding to the very end of the TSP) were significantly higher ( $t = -5.3$ ,  $P = 0.027$ ) SF-1 mRNA levels observed from embryos incubated at female-producing temperatures. These results suggest that the expression of SF1, in the developing adrenal-kidney-gonad complexes, is not a sex-specific regulatory step in the sex determination cascade of these reptiles.

POPULATION DYNAMICS FOR TWO POPULATIONS OF *AMBYSTOMA MACULATUM*. Eric A. Blackwell, Robert A. Angus, and Ken R. Marion. The University of Alabama at Birmingham, Birmingham, AL 35294-1170.

Primarily pond breeders, ambystomatid salamanders migrate from their terrestrial habitats to nearby ponds during breeding season. In northeast Alabama the migration of the spotted salamander (*Ambystoma maculatum*) is a conspicuous event that occurs during late winter. For three breeding seasons (2000 - 2002) an intensive mark-recapture study was conducted on two breeding populations of *A. maculatum* in northeastern Alabama. Drift fences completely encircling an ephemeral and a permanent pond were used to capture all adult salamanders migrating into and out of the ponds. All captured salamanders were marked for identification with passive integrated transponders (PIT tags). The Triple Catch method of population estimation was used to estimate population size, gains and survival rates for each population. Both populations had pronounced female biased size dimorphism. Each population had high survivorship and modest gains indicating stable populations. More salamanders used the ephemeral pond than the permanent pond.

REAL-TIME PCR DETECTION OF *Vibrio parahaemolyticus* O3:K6. Michael L. Myers and Asim K. Bej, Dept. of Biology, Univ. of Alabama at Birmingham, AL 35294-1170.

A relatively rapid and quantitative method was developed for the detection of a microbial pathogen, *Vibrio parahaemolyticus* O3:K6, by using real-time polymerase chain reaction (PCR). Oligonucleotide primers were designed to amplify a 368-bp segment of the open reading frame 8 (ORF8) DNA sequence that is found specifically in *V. parahaemolyticus* O3:K6. The PCR reaction was optimized with the FastStart DNA Master SYBR Green I Kit (Roche) by adjusting magnesium chloride concentration, cycling times, and cycling temperatures. This kit provides a mix with all PCR reaction components except for template DNA and primers. Optimization was also performed separately by using Platinum Taq DNA polymerase (Invitrogen) and adjusting the concentrations of magnesium chloride, SYBR Green I fluorescent dye, and gene-specific primers, as well as cycling times and temperatures. Consistent and sensitive detection was obtained with Platinum Taq DNA polymerase and SYBR Green I dye. The sensitivity of detection using Platinum Taq DNA polymerase was determined to be 10 pg. of purified genomic DNA, as opposed to 0.1 ng. with the SYBR Green I Kit. The applicability of this method for detection of this pathogen in the environment was tested by seeding Gulf water with serially diluted *V. parahaemolyticus* O3:K6 cells. The detection level observed in a 1% (w/v) agarose gel was  $10^3$  cells/100 ml Gulf water. Comparison of boiled template DNA from seeded Gulf water and of purified DNA using commercially available kits exhibited promising results for the applicability of real-time PCR for the detection of this marine pathogen in the environment.

REPRODUCTIVE CYCLE OF THE SEA URCHIN *LYTECHINUS*  
*VARIEGATUS* FROM A SHELTERED BAY IN FLORIDA: A PRELIMINARY  
DESCRIPTION. Adele W. Cunningham and Stephen A. Watts, Dept. of Biology,  
Univ. of Ala. at Birmingham, Birmingham, AL 35294-1170.

The reproductive cycle of *Lytechinus variegatus* was monitored for the last 11 months in a north Florida bay. For both males and females, average gonad mass increased substantially from November to April. An additional peak in average gonad mass occurred in females in September. Qualitative and quantitative analysis of gonad histology is being used to assess the storage capacity of the nutritive phagocytes and the developmental state of the gametes in the gonad. In April and June, urchins were actively producing gametes and have the capacity to spawn. In July, urchins have recently spawned, contained relict gametes, and were renewing nutritive phagocytes. In females, germinal epithelium was the thickest in April, declined in June, and was greatly reduced in July. In females and males, the percent of gonad occupied by gametes was also highest in April, declined in June, and was lowest in July. Size-frequency analysis of oocyte diameters showed the highest frequency of large oocytes in April, the highest frequency of small oocytes in June, and the fewest oocytes at all sizes in July. The presence of immature and mature oocytes in all three months and the range of reproductive stages in each month suggests spawning is initiated at least by April and continues through July. The reproductive state is currently being evaluated for other months. The success of *L. variegatus* in nearshore environments may be a consequence of its ability to produce and release gametes over an extended period, thus, maximizing recruitment and increasing its overall fitness.

RESTRICTION ENZYME SURVEY OF HALOPHILIC AND  
HALOTOLERANT BACTERIAL ISOLATES FROM DIVERSE SALINE  
ENVIRONMENTS. Pat Graham and Donald Salter, University of West Alabama.

Using a high NaCl concentration selective complex growth medium, we have cultured a number of unique and interesting bacterial isolates from three different saline ecosystems: an inland salt spring near Jackson, AL, an estuary near Pensacola Beach, FL, and seawater off Pensacola Beach, FL. Our laboratory has previously characterized their ability to produce different exoenzymes and to grow in a complex growth medium containing several different inorganic components at different concentrations. These halophilic and halotolerant isolates may also produce potentially useful biological molecules such as restriction enzymes with unique properties and unique nucleotide sequence sites. We investigated three extract preparation methods: sonication of broth grown cells, Triton-X100/lysozyme lysis of agar grown cells, and Triton-X100/lysozyme lysis of agar grown cells with subsequent viscosity reduction by repeated passing through a 26-30 gauge needle. The extracts were assayed by incubating with lambda DNA in a commercial restriction enzyme buffer at 37°C for 1.5 hours, and then analyzed for products of DNA degradation by agarose gel electrophoresis and ethidium bromide staining. Twenty-four isolates were screened by these three extract preparation methods and the standard assay. Extracts prepared by the third cell breaking method seem to give more consistent results, was easier to perform, and required less time to complete. One isolate, PG9A, prepared by the third cell breaking technique produced a restriction enzyme that excises lambda DNA into 10 or more DNA fragments. Future research will emphasize re-testing the isolates with the third extract preparation method and determine whether any of the restriction enzymes are unique and potentially useful tools for the biotechnology industry.

SILTATION EFFECTS ON FISH COMMUNITIES IN THE CAHABA WATERSHED. Jaideep Honavar, Robert Angus and Ken Marion, Dept. of Biology, Univ of Alabama in Birmingham, AL 35294.

Excessive siltation of streams has been identified as the leading cause of fish habitat alteration in the southeastern. Although some siltation is natural, anthropogenic sources greatly increase the volume of sediment entering the water body. Increases in turbidity and deposition reduce light penetration and cause local habitat alterations. Fish are sensitive indicators of aquatic ecosystem quality. The Cahaba river system supports a very diverse ichthyofaunal assemblage. Rapid urbanization with associated increases in siltation is occurring in the upper Cahaba basin. Six sites of varying sedimentation impact in the upper Cahaba drainage were assessed in order to measure the effect of siltation on fish community structure. Habitat quality was evaluated using EPA Rapid Bioassessment Protocol. Fish collections were carried out by seining and electroshocking during fall and spring of 2000 and 2001. Fish data were analyzed using an Index of Biotic integrity (IBI), which is a fish assemblage quantification scheme based on abundance and trophic and taxonomic composition of the fish community. Comparing the habitat assessment values with the fish metrics showed a distinct relation that habitat alteration due to siltation led to an alteration in the fish community structure within the assemblage. The IBI was negatively correlated with decreased habitat quality and increased siltation. Sediment – impacted streams also showed decreases in darter abundance, crevice spawning species and sensitive minnows

SUCCESSION IN FISH COMMUNITIES OF AN EPHEMERAL STREAM IN SUMTER COUNTY, ALABAMA. Kathryn Alexander and John N. McCall, Dept. of Biological and Environmental Sciences, University of West Alabama, Livingston, AL. 35470.

The reestablishment of the fish community in an ephemeral stream in Sumter County, Alabama, was followed over a period of 12 months in 2000-2001. Ponkabia Creek is part of the Sucarnoochee River drainage in west-central Alabama. In the early fall of 2000, the stream bed east of Sumter County Highway 28 was completely dry. Rains in late fall of that year flooded the stream bed, and allowed reestablishment of the fish community to begin. Monthly sampling was conducted of the fish community at five sites within the stream. Environmental parameters were also measured. Although a relatively diverse community was established at most sites by the following summer, community composition and diversity continued to fluctuate widely at all sites throughout the course of the study. This suggests that a stable community structure had not been achieved, and that short-term environmental fluctuations may exert significant control on community composition.

STRUCTURAL ANALYSIS OF GREENBUG FEEDING ON SORGHUM PLANTS UNDER DROUGHT STRESS. Mijitaba Hamissou, Biology Department, Jacksonville State University, AL 36265 and Paul E. Richardson, Oklahoma State University, Stillwater, OK 74078

*Sorghum bicolor* (L.) Moench is grown in countries of Africa and Asia as a principal staple food source. In the United States, sorghum production is centered in the Great Plains States. In these areas, sorghum production is hampered by drought and insect infestation. One of the most important insect pests in sorghum is the aphid greenbug, *Schizaphis graminum* (Rondani). Greenbugs exhibit antixenosis for the bloomless sorghum. Sorghum leaves are normally covered with a powdery wax termed "bloom". The condition where there is no wax covering is termed "bloomless." Wax cover was shown to reduce plant's water loss. The objective of this study is to determine the effects drought and greenbug feeding activities on the ultrastructure of sorghum.

Isogenic lines of sorghum, (ROKY62 Bm, ROKY62 bm, ROKY78 Bm, and ROKY78 bm) were grown under controlled environment and field conditions. Drought stress was imposed by withholding water and by measuring plants relative water contents. Greenbug feeding activities were monitored electronically.

Our data indicated that drought stress interferes with the ability of greenbugs to successfully commit to phloem feeding and that salivation frequencies were higher in bloom plants than in bloomless plants under similar conditions. We also observed starch and plastoglobuli built up in the chloroplasts and an increase in the number of mitochondria in plant cells as a response to the aphid feeding.

VERTEBRATE ROAD-KILL SURVEY OF THE MOBILE BAY CAUSEWAY. David H. Nelson, Dept. of Biological Sciences, Univ. of South Alabama, Mobile, AL 36688.

A systematic, road-kill survey was conducted (by bicycle or automobile) on the Mobile Bay Causeway each week during 2001 to assess the numbers of vertebrates killed by vehicular traffic. More than 500 organisms representing 85 species of vertebrates were encountered: 8 amphibians, 25 reptiles, 39 birds and 13 mammals. Southern Leopard frogs (*Rana utricularia*) were the most abundant amphibian (n=8). "Endangered" Alabama redbelly turtles (*Pseudemys alabamensis*) were the most frequently encountered reptile (n=71); most specimens were hatchlings. Laughing gulls (*Larus atricill*, n=42) and American coots (*Fulica americana*, n=32) were the most commonly-encountered birds. Raccoons (*Procyon lotor*, n=47), opossums (*Didelphis marsupialis*, n=41), and nutria (*Myocastor coypus*, n=30) were the most abundant mammals. Data were analyzed by taxon and season. The most significant finding in this ongoing study has been the emergence of 51 hatchlings of *Pseudemys alabamensis* during the month of April. These data confirm overwintering in the nest by the Alabama redbelly turtle.

TELOMERASE (*hTERT*) PROMOTER REGULATION DURING NEOPLASTIC TRANSFORMATION OF WI-38 HUMAN FETAL LUNG FIBROBLASTS. Mark A. Casillas, Scott L. Brotherton, Lucy G. Andrews, J. Michael Ruppert, and Trygve O. Tollefsbol, University of Alabama at Birmingham.

Elucidation of the mechanisms governing expression of the human telomerase reverse transcriptase (hTERT) is important for understanding cancer pathogenesis. Approximately 90% of tumors express hTERT, the major catalytic component of telomerase. Activation of telomerase is an early event, and high levels of this activity correlate with poor prognosis. Recent studies have shown that the transcription factors c-Myc and Mad1 activate and repress *hTERT*, respectively. It is not clear how these transcription factors compete for the same recognition sequence in the *hTERT* core promoter region. Studies have shown that the combined expression of SV40 large T antigen (T-Ag), hTERT, and H-Ras is able to transform human cells. We recapitulated these studies in a distinct human cell type, WI-38 fetal lung fibroblasts, a cell culture system widely used for senescence studies. We transduced cells and enveloped retroviral constructs containing SV40 T antigen, *hTERT*, and activated H-ras. Transduced cells exhibited anchorage-independence in soft agar and expressed increased levels of c-Myc and endogenous *hTERT*. These effects were observed after more than 25 population doublings (PDs) following the establishment of the neoplastic cell line. During the process of transformation, we observed a switch from Mad1/Max to c-Myc/Max binding to oligonucleotide sequences containing the *hTERT* distal and proximal E-boxes. c-Myc can bind specifically to the *hTERT* promoter *in vitro*, indicating that c-Myc expression in tumors may account for the increased expression of hTERT observed *in vivo*. This experimental model provides a means for evaluating mechanisms of cancer initiation, promotion, and progression in WI-38 fibroblasts.



**TELOMERASE MAINTENANCE AND CONTROL IN AGING HUMAN CELLS.** Nathaniel J. Hansen, Nadejda Lopatina, Joseph C. Poole, Lucy C. Andrews, and Trygve O. Tollefsbol, Dept. of Biology, University of Alabama at Birmingham, Birmingham, AL, 35294.

Telomerase, the enzyme that maintains chromosomal ends, has been the subject of significant attention for its role in neoplastic transformation and cellular senescence. The subunit responsible for the catalytic action of telomerase, hTERT, is expressed in some differentiating tissues and in 85-95% of human tumors. However, it is not present in the majority of somatic cell lines, and the mechanisms of transcriptional regulation in the hTERT gene have been sought as potential control points of telomerase function. A portion of the hTERT gene from WI-38 human fibroblasts was targeted for assessment with bisulfite methylation sequencing. Following sodium bisulfite-mediated conversion of cytosine residues to uracil, the presence of unconverted 5-methylcytosine is detected in bisulfite-treated oligonucleotides through genomic sequencing. Using this method, an hTERT target PCR product has been amplified for sequencing. Results in a human teratocarcinoma cancer cell line during a twelve-day course of retinoic acid-induced cellular differentiation have shown a marked increase in hTERT promoter methylation as well as a concomitant decrease in hTERT mRNA expression. While these data suggest a strong association between promoter methylation and silencing of the hTERT gene, published reports indicate that methylation may only play a minor role in a more complex telomerase silencing mechanism in other cancer cell types. Elucidation of tissue-specific modes of hTERT regulation should prove vital for the understanding of tumorigenesis and aging in human cells.

## CHEMISTRY

**SYNTHESIS AND CHARACTERIZATION OF A HIGHLY POLAR AROMATIC LIGAND.** Todd Davis and Steven Arnold, Dept. of Physical Sciences, Auburn Univ. Montgomery, Montgomery, AL 36124

Aromatic compounds containing both electron donor and acceptor substituents are highly polar and their UV spectra are sensitive to solvent polarity and hydrogen bonding. The synthesis of N-(4-nitrophenyl)-N,N'-dimethylethylenediamine is described. This compound is such a highly polar compound and has the potential to be sensitive to the presence of metal ions. The synthesis is described and the results of UV-visible absorption spectra measurements in several solvents are discussed. This research was partially supported by a grant from the Auburn University Montgomery Research Grant-In-Aid Program.

CHEMICAL MODIFICATION OF BAGASSE WASTE FOR OIL ABSORPTION. Mohamed A Abdalla and Adriane Ludwick, Chemistry Department, and Heshmat Aglan, Mechanical Engineering Department, Tuskegee University, Tuskegee, AL 36088.

Cellulose-based materials as waste from various natural sources can be used as oil absorbing materials. Bagasse, from sugarcane, is such a waste cellulose-based material. Modified bagasse has been obtained from its reaction with stearic acid, t-butylamine, and zinc oxide, and sodium hydroxide solution. The oil absorbing properties of this material have been studied. To understand the structure of this modified bagasse, cellulose esters have been synthesized from a stearyl and palmitoyl chloride mixture. Additionally, cellulose was reacted with stearic acid, t-butylamine, zinc oxide, and sodium hydroxide solution, using different proportions of these reagents. The characterization approaches for the comparisons of modified bagasse and cellulose materials include solid state  $^{13}\text{C}$  NMR, IR, TGA and optical microscopy. The extracts from modified bagasse and commercial absorbing material using different solvent are being studied using GC/MS. Preliminary results indicate measurable differences among the materials. A rationale for these differences is suggested.

A COMPARISON OF THE PHYSICAL AND CHEMICAL PARAMETERS OF TWO STREAMS IN WEST CENTRAL ALABAMA. Amber Morgan and Richard Buckner, Department of Biological and Environmental Sciences, University of West Alabama, Livingston, AL 35470.

Alamuchee Creek and Bodka Creek are two streams in Sumter County, AL that flow through different geologic substrates. The physical compositions of the streams are influenced mainly by temperature, stream flow, turbidity, pH levels, and hardness. Most of these depend heavily on the substances dissolved in the water. Important chemical parameters include dissolved oxygen, reactive phosphorus, nitrate, and tannin/lignin. Water samples were collected from each creek once a month for one year to determine the effects of seasonal changes and to compare the physical and chemical parameters. In both streams, phosphorus levels were lowest in the summer months and highest during the winter. Nitrate levels followed a similar pattern. Although these parameters did show seasonal variations, overall seasonal changes played a minor role in the physical and chemical composition of the streams. Changes in the water quality appear to be the result of more short-term events such as rainfall and runoff. In both streams, rainfall was distinctly correlated with the amount of tannin/lignin present. This is more apparent in the Alamuchee Creek because pine trees surround it, whereas the Bodka Creek runs mainly through farmland. Rainfall was also inversely correlated with water temperature and pH. Other significant correlations existed between stream flow and turbidity, and tannin/lignin and turbidity. Water temperature was inversely correlated with stream flow and turbidity.

COMPARISON OF POTENTIOMETRIC AND CONDUCTIVITY METHODS FOR ACID-BASE TITRATIONS. M. B. Moeller and Buket Yanpar, Dept. of Chemistry and Industrial Hygiene, University of North Alabama, Florence, AL 35632.

Acid-base titration is a very mature analytical technique but recent developments in data analysis and equipment warrant additional study of this common laboratory practice. A paper by Schwartz 1987 described a method for transforming pH titration data which has the effect of producing a straight line response to titer volume. In this method, the equivalence point is obtained from the x-axis intercept. A recent theoretical study suggested that the precision of the Schwartz plot would be superior to both conventional pH derivative methods and to conductivity titrations. We have experimentally examined the precision of these three titration techniques. Using 0.251 M sodium hydroxide titer, samples of KHP ( $pK_a = 5.41$ ) and boric acid ( $pK_a = 9.21$ ) were titrated having both a glass pH electrode and conductivity electrodes or both a glass pH electrode and an ISEFET pH sensor simultaneously monitoring the system. Ten titrations were performed with KHP and six with boric acid. Significantly ( $\alpha=.05$ ) better precision over the conventional second derivative analysis method were obtained by both conductivity titrations and by Schwartz plot analysis of pH data, with the endpoints from conductivity titrations showing slightly better precision. Our investigation also compared the performance of an ion sensitive field effect transistor (ISEFET) pH sensor to that of a glass pH electrode. This study did not find significant difference in the precisions obtain using the ISEFEET pH sensor compared with results from the glass pH electrode.

NEW POTENTIAL ENERGY SURFACES FOR NE INTERACTING WITH NII.  
U.Schmupf, Department of Chemistry, Troy State University, Troy, Alabama 36082. G. Kerenskaya and M.C.Heaven, Department of Chemistry and Cherry L. Emerson Center for Scientific Computation, Emory University, Atlanta, Georgia 30322

Potential energy surfaces were calculated for the singlet states derived from the  $\pi^2$  configuration ( $a^1\Delta$ ,  $b^1\Sigma^+$  and  $c^1\Pi$ ). *Ab Initio* calculations were performed at the CASPT2 level of theory (CAS(4,4)), using Dunning's augmented basis sets (*spdf* for Ne and N, and *spd* for H). BSSE corrected energies were obtained by extrapolation to the complete basis set (CBS) limit by systematically increasing Dunning's basis set from avdz to av6z.

Potential surfaces for the  $a$ ,  $b$  and  $c$  states are similar in their topology. The global minimum for all of these surfaces correspond a linear, hydrogen-bonded configuration. Secondary minima are found for collinear Ne-NII. The orbital degeneracy's of the  $a^1\Delta$  and  $c^1\Pi$  states are lifted by side-on approach of the Ne atom, but this splitting is a minor perturbation, consistent with the fact that the states arise from a  $\pi^2$  configuration.

In agreement with the experimental data, the depth of the Van der Waals interaction increases on  $c$ - $a$  excitation, and the equilibrium bond length contracts. Bound state calculations predicted dissociation energies ( $D_0$ ) and bond lengths ( $\langle R \rangle$ ) of 16.6  $\text{cm}^{-1}$  and 4.01 Å for the  $a$  state, and 24.5  $\text{cm}^{-1}$  and 3.70 Å for the  $c$  state. The predictions for the  $a$  state are reasonable, while the average bond length for the  $c$  state is too long. It was noted that the zero-point energy in the  $c$  state (71.8  $\text{cm}^{-1}$ ) takes up 75% of the binding energy, causing underestimation of the  $D_0$  value and the monomer to complex red shift.

## GEOGRAPHY, FORESTRY, CONSERVATION, AND PLANNING

Information System to support the redevelopment of Brownfields Sites in the City of Prichard, Alabama. Charmain McMillan and Donald E. Outland, Department of Community Planning and Urban Studies, Alabama A&M University, Normal, Alabama 35762.

In 1996 the City of Prichard, Alabama was selected by the Environmental Protection Agency (EPA) as a Regional Brownfield Pilot. Prichard lacked the resources and trained personnel to expeditiously provide market information requested by land developers and thereby support the Brownfields redevelopment process. A private/public academic partnership was formed to assist the city in developing a GIS based information system to support Brownfields redevelopment. The Partnership included universities, state and local government, the private sector and a major national research facility. Two of the partners, Alabama A&M University and Oak Ridge National Laboratories collaborated to develop property information and query toolboxes - a user-friendly mechanism for capturing, editing, and querying data. The system was designed to permit inexperienced GIS users to prepare and maintain the information system and provide requested profiles on Brownfields properties for prospective developers. This student paper presents the use of the property information toolboxes and the query tool to build and query the database. Tax parcel, Brownfields assessment, land use, socioeconomic and environmental data on 17 sites was captured from separate sources and encoded into the system. The system will facilitate sound decision-making by all stakeholders with an interest in participating in the Brownfields redevelopment process. It also presents a model that may be replicated in other cities.

## DIVERSIFYING COMMUNITY INVOLVEMENT IN WATERSHED PLANNING

William K. McAllister, Dept. of Community Planning and Urban Studies, Alabama A & M University, Huntsville, AL

Everyone on earth lives in a watershed, but not all shareholders in the same watershed share in its fundamental contributions to the quality of life, such as clean water. When water becomes contaminated, even in a short stream segment, local people need to be involved in the solutions. In many small rural valleys formed by watersheds, the physical features set the stage for a sense-of-community similar to that provided by a town. In some watersheds, incorporated municipalities are in short supply and the physical valley and its activities have the greatest influence on community identity. The Paint Rock River Valley within the Alabama portion of the Tennessee River basin and the Applegate Valley straddling the Oregon and California state line are examples. Both are located just outside the urban-rural fringe of growing metropolitan areas. Increasingly, these areas are seeing more new residents. Both areas include diverse community involvement in watershed planning activities as a result of water quality issues. Timber owners and farmers are collaboratively planning with environmentalists, historic preservationists, and others for cleaner water in these valleys. This research looks at the value of planning in diverse natural, social, and economic environments by breaking away from planning based on political boundaries, to planning based on natural watershed boundaries. The recent move under the Clean Water Act for more and broader involvement in non-point pollution solutions, as well as the move to ecosystems planning and management by the four largest U. S. land management agencies both support watershed-based planning in combination with more diverse community involvement.

## FREQUENCY AND INTENSITY OF ALABAMA TROPICAL CYCLONES

Philip Chaney, Department of Geology and Geography, Auburn University.

Tropical cyclones represent a significant threat to Alabama's coastal and non-coastal residents from wind and water damage (storm surge and/or flooding). The objective of this study, therefore, was to evaluate the basic characteristics of tropical cyclone activity in Alabama. The study was based on a tropical cyclone database maintained by the National Hurricane Center known as HURDAT (a.k.a. best tracks). Seventy-two tropical cyclones crossed Alabama's borders during the period 1886-1999 (0.63 per year). Intensity (maximum wind speed) of the cyclones while crossing Alabama was as follows: 15 hurricanes (65 knots or greater), 36 tropical storms (35-60 knots), and 21 tropical depressions (30 knots or less). Fifteen cyclones made landfall along the Alabama Coast, with 7 being hurricanes at landfall. Frederic (1969) was the most intense at landfall (115 knots; category 4 on Saffir/Simpson Scale). Frequency of tropical cyclones in Alabama was significantly greater during the period 1886-1939 (8.3 per decade) than during the period 1939-1999 (4.5 per decade). Regression analysis showed no relationship between frequency of cyclone development in the North Atlantic Basin and frequency of cyclones observed in Alabama over the entire study period, but a moderate relationship was detected over the last 5 decades (1950-1999).

FORESTS OF SUMTER COUNTY IN THE TWENTY-FIRST CENTURY. Wilbur B. De Vall, Proxy Services, Ltd., Auburn, AL 36830.

The forests of Sumter County have played a significant role in the economy of Alabama since the early part of the twentieth century. They have supported sawmills, pulp and paper mills, and other wood products businesses. Their status today is still important to the economy and is evaluated in this paper. According to a 1999 survey, 74% of the land area supports forests. Of the 431,000 acres of forest, most is in private, non-industrial ownership. Industry owns but 35%. Forest types are limited with pine stands representing 154,000 acres or 36% and hardwood/hardwood pine stands combined totalling 277,000 acres or 64%. Tree sizes are principally in the sapling/seedling sizes and represent the future potential of the forests. Saw timber-sized trees occupy 135,00 acres or 31% of the total, while pole-sized trees suitable for pulpwood occupy 76,000 acres or only 18% of all sizes. Growth of the forests is now 31 million, cubic feet. The softwood component accounts for 68% or 21 million cubic feet and the hardwood segment 32% or 10 million cubic feet being added to the total. Growth is based on all trees of commercial size. Harvesting amounts to 32 million cubic feet of which 59% is from pine stands and 41% from hardwood types. At the turn of the century, ownership is 60% in non-industrial, private holdings which places great significance on the future potential of County forests. Although 64% is classed as hardwood and 51% is not merchantable, the latter represents the future potential. While growth is 68% in stands of pine, the majority harvested (59%) comes from these stands. The future of Sumter County forests appears assured because growth of softwood types exceeds the harvested rate by 8% and hardwood growth exceeds the harvest by 43%.

PHYSICS AND MATHEMATICS

A COMPARISON OF MODELS OF EXCITABLE CELLS, Kenneth R. Swinney, Bevill State Community College, Fayette, AL 35555. Richard A. Gray, Cardiac Rhythm Management Laboratory, University of Alabama at Birmingham.

The study of excitable cells is an active area of interdisciplinary research that involves a considerable amount of applied mathematics and physics. After a pedagogical review, we show that the Endresen Model for the potassium, calcium, and sodium concentrations inside an excitable cell can reproduce the Hodgkin-Huxley formulation for the membrane action potential. Our purpose is twofold; first to encourage the inclusion of Biological Physics examples in undergraduate courses and to present an interesting new result.

DISTRIBUTION OF CONTINENTS AND ISLANDS AND THEIR MULTI-FRACTAL CHARACTERS. A. Tan and W. Lyatsky, Department of Physics, Alabama A & M University, Normal, AL 35762.

The size distributions of the continents and islands as a result of the fragmentation of the original landmass Pangaea are studied in terms of the cumulative number  $N$  and the area  $A$ . A plot of  $N$  in logarithmic scale against  $A$  shows two straight lines, one representing the continents plus Greenland and the other representing the rest of the islands. In this distribution, Greenland is elevated to the status of a continent. A plot of  $N$  in log scale versus  $\sqrt{A}$  defines four straight lines. The continents, the large islands (from New Guinea to Great Britain) and the small islands are represented by three straight lines whereas a fourth straight line lumps Australasia and Greenland together, the latter thereby losing their continental status in this plot. A plot of  $N$  in linear scale versus  $\sqrt{A}$  shows three straight lines representing the continents (including Greenland), the large islands and the small islands. Australasia and Greenland regain their continental status in this plot. Finally, a fractal plot of the reciprocal of  $N$  in log scale against  $\log A$  betrays five straight lines thus demonstrating the multi-fractal character of this distribution.

FRACTURE MODEL FOR SCORING IN N. B. A. BASKETBALL. A. Tan,  
Department of Physics, Alabama A & M University, Normal, AL 35762.

In the 2000-2001 season, the average number of points scored by each team in an NBA basketball game was about 100. The average points scored by the 12 players in the roster were 21.3, 16.7, 13.0, 11.3, 9.2, 8.1, 7.0, 5.9, 5.1, 3.8, 2.1 and 1.1 respectively, in descending order. The cumulative points scored followed an exponential pattern, which is the same pattern as the cumulative distribution of lengths of fragments in a random fragmentation of a one-dimensional object. Thus, the points scored in NBA basketball behaved like a linear magnitude and the fracture model of a linear object fits the description of points scored in NBA basketball.

GEOMETRY OF THE HOOK BALL TRAJECTORY IN BOWLING. A. Tan and  
W. Lyatsky, Department of Physics, Alabama A & M University, Normal, AL  
35762.

The superiority of the hook ball over the straight ball in bowling is analyzed from a purely geometrical perspective. The hook ball has a distinct geometrical advantage over the straight ball in both hitting a spare and making a strike. In hitting a spare, the lateral displacement of the hook ball is smaller by a factor of  $\cos\theta$  compared with that of the straight ball for the same error in release angle, where  $\theta$  is the hook angle. In making a strike, this factor is even greater and equal to  $\frac{1}{2} \cos\theta \operatorname{cosec}(\pi/3-\theta)$ .

Gravitational Waves from a Dilatonic Black Hole.  
Govind Menon, Troy State University, Troy, AL 36082.

The perturbations of the Kerr-Newman dilatonic black hole background is to be carried out in order to study the emerging gravitational waves. If these quantities have a measurable contribution, this would provide for a test of Super String theory. For this purpose we perform a double expansion in both the background electric charge and the wave parameters of the relevant quantities in the Newman-Penrose formalism. We then display the gravitational, dilatonic, and electromagnetic equations, which reproduce the static solution (at zero order in the wave parameter) and the corresponding wave equation in the Kerr background (at first order in the wave parameter and zero order in the electric charge). At higher orders in the electric charge one encounters corrections to the propagation of waves induced by the presence of a non vanishing dilaton.



JUPITER AND THE IO CURRENT WING. Duane H. Pontius, Jr., Dept. of Physics, Birmingham-Southern College, Birmingham, AL 35254.

Jupiter's satellite Io produces a standing magnetospheric disturbance that has been studied in situ by spacecraft and remotely by telescopic observations. Known as the Io current wing, this disturbance supports an electric current system stretching a quarter of a million miles between Io and Jupiter. In Jupiter's ionosphere, it produces a sharp, bright auroral spot visible from Earth. This paper generalizes previous analytic treatments and shows that the governing magnetofluid equations are equivalent to a nonlinear second-order partial differential equation for a single scalar function of position. This equation bears a strong resemblance to the velocity potential equation for two-dimensional compressible flow in an ideal inviscid fluid, a classical problem in hydrodynamics. Pursuing the analogy provides important insights into the nature of this amazing phenomenon and reconciles two competing theoretical models proposed decades ago to explain it. (Research supported by NASA's Supporting Research and Technology Program and Birmingham-Southern College)

Making ALEKS Work for Intermediate Algebra at U.W.A. Hazel Truelove and Kim Giles, Department of Mathematics, University of West Alabama, Livingston, AL 35470.

The Department of Mathematics at the University of West Alabama has consistently tried to reconcile the needs of the students and the needs of the university in the area of developmental mathematics. The challenge of developing a program that addresses the fact that 73% of our entering freshmen are required to take some form of remedial math and the desire of the university to limit the number of courses was resolved with the adaptation of the internet course ALEKS, Assessment and Learning Knowledge Spaces. ALEKS is an internet program based on the concept of knowledge spaces. This means that a student progresses through a set of objectives. Concepts will not be introduced until the prerequisite skills have been mastered. ALEKS provides the material for remediation and the staff at the University of West Alabama has developed a means through which it can be used efficiently. By providing the student with a workable format, the Department of Mathematics has created a program that takes a student through a series of basic math and algebra objectives in a time span determined by the level of the student's mathematical skill upon entering the university and his/her initiative.

ON PROFINITE GROUPS WHOSE POWER SUBGROUPS ARE CLOSED. Jon M. Corson, Department of Mathematics, University of Alabama, Tuscaloosa, AL 35487. Thomas J. Ratkovich, Department of Mathematics, University of West Alabama, Livingston, AL 35470.

We say that a profinite group  $G$  has Property S if for each integer  $n$ , there is a bound  $k$  such that every element of the  $n$ th power subgroup  $G^n$  is a product of  $k$   $n$ th powers of elements of  $G$ . Finitely generated profinite groups with Property S are completely determined by their group structure in a way conjectured by Hartley to be true of all finitely generated profinite groups; namely, every subgroup of finite index is open. We show that the class of finitely generated profinite groups with Property S is closed under forming extensions of its members and under taking subgroups of finite index. As a consequence, we note that all profinite groups of finite rank have Property S.

ON RESOLVENT FORMULA FOR PSEUDO-HERMITIAN OPERATORS. Sergey Belyi, Dept. of Mathematics & Physics, Troy State University, Troy, AL 36082.

The canonical Krein resolvent formula describes the resolvent difference of two self-adjoint extensions  $A_1$  and  $A_2$  of a densely defined symmetric linear operator  $\dot{A}$  with finite equal deficiency indices. The class of pseudo-Hermitian operators was first introduced in 1970's as a certain generalization for the known classes of symmetric extensions of symmetric linear operators. Recent developments related to the description of the coefficients of the Krein's formula have motivated us to apply new approach to the class of pseudo-Hermitian operators. We show that the Krein formula also holds for the class of pseudo-Hermitian extensions of a symmetric operator  $\dot{A}$  and state some additional results related to the coefficients description. To provide a proper treatment of pseudo-Hermitian extensions we use the rigged triplets of Hilbert spaces.

INDUSTRY AND ECONOMICS

ECONOMIC RECOVERY POLICIES OF THE UNITED STATES AFTER THE SEPTEMBER 11TH TRAGEDY, Eric Rahimian, Dept. of Economics, Finance and Office Systems Management, Alabama A&M University, Normal, AL 35762.

The U.S. appeared to be in a mild recession, when the September 11<sup>th</sup> attack occurred. Due to the destruction in New York, the American Stock Market closed until September 17, 2001. All major stock indices (DJIA, NASDAQ, S&P 500) fell between 12 and 18 percent during the first week of operation. The impact of the attack was felt in travel, retail, wholesale, manufacturing and other industries. The unemployment rate continued rising reaching 5.4% in October and 5.9 % in December. The Purchasing Managers Index dropped from 47 in September to 39.8 in October. Some feared that investors might panic and pull their money heavily out of the U.S. markets. The Federal Open Market Committee that had reduced the short-term interest rates seven times, lowered them again four more times to stabilize the U.S. markets. The federal funds and discount rates were respectively 3% and 2.75% in early September 2001 and were reduced to 1.75% and 1.25% by the end of the year. On the other hand, partisanship in Congress and the Anthrax scare mitigated the passage of a broad-base fiscal stimulus package. Fortunately, the timely expansionary monetary policy, the tax reliefs for victims' families, and the increase in defense expenditure seem to have been effective in sparking a recovery. Also, the resilience of consumer demand reduced the inventories and companies started hiring. About 66,000 new jobs were added in February 2002. The Purchasing Managers Index rose from 39.8 in October to 54.8 in February 2002. Considering the recovery prospect, the Fed has left the short-term interest rates the same since January. Congress has also rethought the magnitude of fiscal stimulus needed. The recovery however is not expected to be too fast if consumers' debt dampens the demand.

## EVALUATION AND PROSPECTS OF INNOVATIONS AND ECONOMIC DEVELOPMENT OF UKRAINE DURING TRANSITION TO MARKET ECONOMY

Eric Rahimian, Dept. of Economics, Finance and OSM, Alabama A&M University, Normal, AL 35762 and Andrey Martovoy, Tavrida National Vernadsky University.

This paper attempts to assess the extent and impact of innovations occurred in Ukraine during its transition to market economy. To quantify the innovations, the new technological processes and products are counted. We have utilized two systems of indices, mainly the “2001 Innovation Scoreboard” used by European Commission and “STI Scoreboard 2001” used by OECD, to establish the framework and methodology of our research. There are four phases in developing an innovation-prone environment, including developing human resources, creation of new knowledge, transmission and application of the new knowledge, improving performance and economic growth. These phases and the environmental factors are represented by 33 indices measured for Ukraine. The transition period suffered from economic hardship. Nevertheless, positive trends in most indices of innovations are detected. Innovations seem to be the source of Ukraine’s economic growth in year 2000. Some indices related to developing human resources and creations of new knowledge (share of S&E student enrollment, high tech patent applications received by the State Dept. for Intellectual Property) seem to be comparable with the U.S. and E.U. in some years. Nevertheless, due to importance of all phases of innovation development for economic growth, the policymakers should continue to focus on all phases of innovation development. The environmental safety seems to show improvement after independence, but it still needs special attention. Finally, based on the recent data and current conditions, prospects of economic development are discussed and some recommendations are made.

## EDUCATION, UNEMPLOYMENT AND POVERTY IN ALABAMA: PROBLEMS AND SOLUTIONS. Fesseha Gebremikael, and Eric Rahimian, Dept. of Economics, Finance, and Office Systems Management, Alabama A&M Univ., Normal, AL, 35762.

In 1990, one out of every three Alabama adults did not have a high school education. By 1998, that average had dropped to about one out of five. The Census information indicates that significant differences remain with regard to age and race. The educational attainment gap between blacks and whites, however, narrowed as a large proportion of black students obtained high school degrees. In 1999, about 82% of whites and 79% of blacks were high school graduates. The south has the lowest educational attainment level of any region of the country. Alabama’s educational attainment level, though below national average, has risen to the point that the state no longer ranks among the last 10 in the nation. According to data from Alabama Dept of Industrial Relations the unemployment rate decreased from 5.8% in 1995 to 4.6% in 1997. The national average was at 4.9% in 1997. Although per capita personal income for all counties in the State has increased for several years, proper policies are needed to alleviate the severe poverty in the black belt and other areas. Alabamians are investing approximately two percentage points less of their public budgets on higher education than 10 years ago. The level of funding provided to Alabama higher education has been below averages for the southern region for years. With the advent of the information age, increasing skill levels are critical to success in the global economy. Their impact, however, will be limited without corresponding investment by the private sector in the new technology and production processes that make workers more productive. A strategy for achieving a significant economic impact is to invest in proven techniques and promising reform approaches that will improve the performance of less-advantaged groups.

POVERTY & HOMELESSNESS, WHY CAN'T WE ELIMINATE THEM? Charles Briggs, Department of Economics, Finance and Office Systems Management, Alabama A&M University, Normal, AL 35762.

Poverty and homelessness are two of the complicated issues facing our society. The factors that prohibit society from eliminating these problems are as varied as the causes. In 1999, thirty-two million Americans, 11.8% of the total population, lived in poverty.

The issues surrounding the definition, causes and measurement of poverty have made it difficult to seek a long-term solution for this problem. The first step is to understand what the word "poverty" means and how it should be measured. Despite news clips about our robust economy and newfound wealth of so many, there is still creeping dissatisfaction with the distributions of the wealth. Clearly, the gap in economic well-being between whites, African Americans and other ethnic groups is widening. Over two million American men, women, and children are currently homeless. Homelessness has remained stubbornly resistant to government policy prescriptions. The homeless population is diverse. About 37% of them are families with children, 25% are children, 25-30% are mentally disabled, 30% are veterans, and 40% are drug or alcohol dependent. There is a positive correlation between poverty and homelessness. This paper explores recent demographic statistics of the poor and homeless in America. It also studies the causes, consequences and remedies to reduce poverty and homelessness. Recommended policies must address lack of affordable housing, lagging incomes, slashed services and government assistance. The government may legislate laws to ensure a living wage, adequate support for those who cannot work, affordable housing, and access to health care to reduce the number of poor and homeless in the future.

PROTECTING INDIVIDUAL INFORMATION ON THE INTERNET. Paulette S. Alexander, University of North Alabama, and James G. Alexander, Alabama A&M University.

The phenomenon of the Internet continues to expand exponentially. Growth includes individuals using the Internet for business and as a resource for information and entertainment. Concern for the privacy of individual, personally identifiable information that is collected on the Internet is widespread. Information can be collected on the Internet in two fundamental ways: it can be provided consciously by the Internet user, or it can be collected surreptitiously, without the user's knowledge. Once information is collected, little control exists concerning its subsequent use, maintenance, accuracy or disposal. It is, therefore, imperative that individual Internet users maintain a high level of awareness of the ways that personal, personally identifiable information is collected. This is a relatively straightforward, though risky, process for information that is directly provided in the transaction of ordinary business. Responses to questions should be limited to a need to know items. A page's "privacy notice" should be reviewed before deciding to do business there or to provide personal information. Also guidelines similar to those employed in other business modalities--e.g., doing business only with reputable companies--should also be employed in Internet use. Questions emerge as to how to assure that information privacy is protected in the environment of providing information essential to complete transactions, and providing information because it is specified as "required" for further movement through the transaction or information-gathering process. And even more difficult questions emerge regarding how to protect personal/personally identifiable information in an environment where surreptitious collection is possible. Present Internet applications allow relatively unregulated intentional collection of personal information from hard drives and tracking of clicks by many organizations to determine surfing patterns and details without the direct knowledge and acquiescence of the Internet user. In the absence of needed regulations prohibiting collection of information without the informed consent of the information subject, Internet users should establish personal habits that incorporate awareness of the possibility for improper or unauthorized use of consciously-provided information. These habits should be supplemented by routine use of firewall software, high security settings for browsers, and minimal use of "always on" capabilities. Internet users can also protect their personal information from surreptitious collection by implementing the following strategies: routinely remove certain data from their hard drives (e.g., "cookies"), "opt out" of information sharing by financial institutions, telecommunications companies, health care providers, and Web pages.

## PUBLIC SCHOOLS' EXPENDITURES AND STUDENTS' PERFORMANCE

Eric Rahimian, Dept. of Economics, Finance and Office Systems Management, Alabama A&M University, Normal, AL 35762

Expenditures for public schools have been increasing along other government expenditures' while students' performance in mathematics, science, reading and writing has lagged behind several other nations for several decades. Some argue that we need to increase the schools funding to improve the performance. The lower level of expenditure per student by other nations, however, implies that there are other explanations for our students' poor performance. The most important factor is probably teacher quality. Linda Darling-Hammond in *education Policy review, Vol. 8 No.1* has shown a positive correlation between this factor and students' achievement. Teacher quality consists of general academic preparation, intelligence, verbal ability, subject matter knowledge, understanding the learning process, and the teachers' behavior and practices. To assure proper teacher quality, a teacher certification process including the quality factors, must be mandated. Other factors for performance improvement include a performance-base evaluation system, familiarity with the students' cultural and psychological traits, and the class size. Currently the U.S. is striving to improve schools through the "No Child Left Behind Act," which became law in January 2002. President Bush has expressed support for "a new era of accountability" in which the parents will have more information about their children's school performance. Under this law, school districts have more discretion in using federal funds. The law allocates over \$3 billion for teacher training and recruiting, 35% more than last year's allocation. As we celebrate the increase in funding, this paper recommends careful planning for improving the teacher training, certification, and recruiting.

## UGANDA'S ECONOMIC GROWTH IN THE LAST DECADE, Aggrey Bigala and

Eric Rahimian, Dept. of Economics, Finance and Office Systems Management, Alabama A&M University, Normal, AL 35762

The economy of Uganda has shown a steady recovery since 1987 when the Government of Uganda put in place an economic recovery plan. The Government reform program has succeeded in imposing fiscal discipline, restructuring public expenditure, opening the economy, and anchoring it's reliance on market forces. Uganda has achieved notable success over the past decade in maintaining high rates of economic growth in a low inflation environment, and has made considerable progress in poverty reduction through the Poverty Eradication Action Plan (PEAP), adoption of prudent fiscal and monetary policies, and structural reforms. As a result of Uganda's commitment to reforms, annual growth rate of gross domestic product (GDP) averaged six percent in fiscal years 1986-1994 and eight percent in 1995-1996. In 1997, GDP growth rate slowed to five percent and remained at that level for 1998. Recent lower GDP growth rates are attributed to poor performance in the agricultural sector (bad weather), and smaller increase in direct foreign investment. As a result of strong economic growth, Ugandan economy almost doubled in size in the past ten years. Despite good growth figures, Uganda remains one of the poorest countries in the world with low per capita income and high rural poverty ranking 159 out of 175 nations in the UNDP's 1997 Human Development Index. Although Uganda experienced twelve years of political stability and economic reform, it still has several problems including corruption, HIV/AIDS, huge debt, and poor infrastructure. The continuation of growth will depend on the Government's ability to address these problems, attract foreign investment, improve infrastructure, and implement regional economic integration in East Africa.

**WATERSHED PLANNING AND SOCIO-ECONOMIC FACTORS.** William K. McAllister, Dept. of Community Planning and Urban Studies and Eric Rahimian, Dept. of Economics, Finance and Office Systems Management, Alabama A & M Univ., Huntsville, AL.

After passage of 1972 Clean Water Act, pollution control emphasis moved from point source pollution (pipes) to non-point source pollution (diffused). During the 1990s, EPA and local agencies developed an effective permitting system for point sources. The more difficult focus is now directed at broader land use practices that contribute to stream degradation, especially after heavy precipitations. For instance, the watersheds that feed the streams that come under scrutiny for failing current water quality standards must be examined for upstream pollution from land development, resource extraction, and resource production activities. Decisions to sell or lease land for new uses are often made by local people who are unaware of the cumulative impacts of their actions on current water quality. New rules from the Environmental Protection Agency call for local elected officials and the public to be more involved in non-point source solutions. Yet, we know little about the people living in watersheds because U. S. Census data are not tabulated based on watershed areas. This research looks at ways to geographically align socioeconomic data from the Census to watersheds so that planners, researchers, and others may initially screen different watershed data based on various criteria. Census block statistics are used. Block data can help identify economic and social factors among and within watersheds prior to conducting field investigations. Such information can be significant to understanding economic and social consequences of riverine degradation, and the groups of people that need to be involved in shaping and utilizing clean water outreach plans and programs.

## SCIENCE EDUCATION

**48 HOURS OR LESS: A RESEARCH EXPERIENCE FOR GENERAL CHEMISTRY STUDENTS.** Barbara G. Rackley, Adriane G. Ludwick, Melissa S. Reeves, and Kyle R. Willian, 102 Armstrong Hall, Dept. of Chemistry, Tuskegee University, Tuskegee, AL 36088.

In this paper, we make the argument that a research experience early in the college career is useful, even if the time is extremely limited. Many college students participate in summer research programs each year and have a satisfactory experience where the results of a project can be presented at the student's home institution, a conference, or in exceptional cases, the student may be a co-author on a publication. Unfortunately, however, many have unsatisfactory experiences that often arise when the student or mentor is unprepared. At Tuskegee University, the summer program CReATE, Chemistry and Research for the Advancement of Tuskegee-Educated Scientists and Engineers, includes a research experience component for the students. These underclass students taking General Chemistry only spend six hours per week in the research laboratory for the eight-week program. We have found that a central control structure to facilitate the student-mentor relationship, to train the student in research project basics, and to supervise the final project presentations is an essential feature of a summer research program. (Support by the National Science Foundation is acknowledged.)

BIOLOGY LABORATORY EXERCISES FOR THE VISUALLY IMPAIRED. Roland R. Dute, Sarah L. Lanier, Brandy McKinnell, Brittney M. Whitman, Maureen D. Haynes, Colleen Moynihan and Tracy D. Donald, Auburn Univ. 36849

It is the goal of this project to make biology available to visually impaired students throughout Alabama and the Southeast by the manufacture of laboratory exercises in braille and tactile images. These exercises include diagrams, life cycles etc. that are typically found in biology laboratory manuals. Braille diagrams are manufactured in the following manner. Enlarged diagrams of life cycles, cell types, etc. are drawn on 17 X 11 inch paper sheets in heavy black marker. These drawings are delivered to the Assistive Technology Lab in The Program for Students with Disabilities where descriptive terms next to the drawings are translated into braille and cut and pasted over the handwritten terms. The drawings with bold lines and brailled labels are then copied onto 17 X 11 thermoform paper. The thermoform paper version of the drawing is put through a Tactile Image Enhancer where the heat process raises any black image, but the background paper remains flat. The result is a two dimensional drawing on thick, rubbery paper with raised lines and braille descriptors. Included with each exercise is a brief braille text. The quality of the diagrams and text is assessed by a science education graduate student experienced in braille. Completed exercises will be bound and stored in the Assistive Technology Lab. This material will be available on loan for institutions throughout the Southeast. This project is partially supported by a grant from the Daniel F. Brecken Endowment for Faculty Enhancement Program at Auburn University.

BRINGING IT ALL TOGETHER – A MULTIDISCIPLINARY FIELD COURSE IN THE NATURAL SCIENCES. Steven D. Carey, Department of Natural Sciences, University of Mobile, Mobile, Alabama 36613.

A one week, writing intensive, 3-semester hour field course in ecology and geology was offered in May, 2000 by the University of Mobile's Department of Natural Sciences. Students registered for either Biology 497, Ecology of the Desert Southwest, or Earth Science 497, Geology of the Southwestern United States, depending on whether they needed biology or earth science credit. Both courses were taught concurrently, and all students visited the same locations including Carlsbad Caverns National Park, Valley of Fires Recreational Area, White Sands National Monument, and Living Desert State Park (New Mexico). On-site activities differed depending on the student's choice of subject; however, topics in both disciplines were integrated throughout the course. All students were required to maintain a field journal and to write a research paper upon their return to campus. Student satisfaction with the course was high. Post-trip discussions with students indicated an enhanced understanding of the subject material by the use of the multidisciplinary approach.



**COMPLETING STATE SCIENCE EDUCATION REQUIREMENTS FOR  
TEACHER CERTIFICATION THROUGH THE USE OF MINI-COURSES.**

Shirley D. Rohrer, Department of Natural Sciences, University of Mobile, Mobile, AL 36613.

Science mini-courses have been developed in order to facilitate meeting the state education requirements for teacher certification. These courses are designed especially for the credit hour needs of students transferring into our university. The mini-courses are only offered to those students entering with insufficient quarter-system credits and those students deficient in science credit hours due to changes in the minimum state requirements for teachers. To date, the science courses with laboratory participation (2 credit hours) have been taught in a variety of subject areas: entomology, dinosaurs, microbiology, and marine biology. Attempts were made to provide education majors with subject-area ideas and materials that can be utilized in their future teaching careers. Grades earned have been comparable to those in the standard four credit hour lab science classes. Student responses to and education faculty evaluation of the mini-courses have been positive.

**USING SCIENCE OLYMPIAD EVENTS TO TEACH THE NATIONAL  
SCIENCE EDUCATION STANDARDS.**

Jane D. Nall, UMS-Wright Preparatory School, Mobile, Alabama 36607.

“Devoted to improving the quality of science education, increasing student interest in science and providing recognition for outstanding achievement in science education by both students and teachers” identifies some of the major goals of Science Olympiad. Participation in Science Olympiad has steadily grown since its inception in 1982; over 14,000 K-12 schools participated in the United States and Canada in 2001. Science Olympiad has been active in Alabama since the mid 1980s, and this year Alabama ranks in the top 10 in the nation and Ontario for numbers of teams in the junior and senior high divisions. Science Olympiad tournaments incorporate team effort in a competition of events utilizing all science disciplines.

Since the release of the National Science Education Standards by the National Research Council, Science Olympiad has enhanced inquiry-based science programs, monitored the ongoing assessment of teaching and student learning of science concepts, and incorporated technology.

In 2002, seven Alabama colleges and universities and two high schools hosted 8 regional tournaments and 2 state tournaments. Additional hosts are needed to meet the growth of Science Olympiad in Alabama. This presentation will correlate the National Standards with Science Olympiad events and present a summary of 2002 participation in Alabama Science Olympiad.

IMPROVING STUDENT LEARNING IN PRECALCULUS AND CALCULUS THROUGH EFFECTIVE USE OF TECHNOLOGY, Kenneth R. Swinney, Sandy Swinney, Harold Rowell and Tarsh Freeman, Math and Science Department, Beville State Community College- Fayette Campus, Fayette , AL 35555

The mathematics faculty at the Fayette Campus of Beville State Community College received a National Science Foundation: Department of Undergraduate Education, Course, Curriculum, and Laboratory Improvement grant (DUE-0087815) to incorporate computer exercises in courses ranging from MTH12, Precalculus Algebra to MTH238 Applied Differential Equations. We describe our experience in writing a grant proposal, purchasing equipment, and evaluation materials. The materials used are described, including Mathead tutorials developed in house. We give preliminary results obtained using these materials. We also discuss the difficulties of incorporating computer exercises with require significant time in the lab. We would like to require a laboratory section, but this is a problem because the tow year institutions are restricted to offering only those courses listed in the Alabama College System Course Directory.

## BEHAVIORAL AND SOCIAL SCIENCES

ASSESSING COMMUNITY HEALTH WORKERS' COMPLIANCE WITH HEALTH INTERVENTIONS. Theresa A. Wynn and Mona N. Fouad, Dept. of Medicine, Univ. of Ala. at Birmingham. Trinita H. Ashford, Dept. of Obstetrics and Gynecology, Univ. of Ala. at Birmingham, Birmingham, AL 35294.

Community health advisors (CHAs) are instrumental agents of change who are capable of bridging the cultural mediation between the community and the health/social service system. As trusted, natural helpers, CHAs use culturally sensitive approaches to augment the health of underprivileged communities. Given the proliferation of programs that utilize principles derived from the Community Health Advisor Network Model, the main objectives of this study were to: 1) assess the degree that trained CHAs complied with a community-based health intervention protocol; 2) explore the challenges and barriers CHAs faced during the natural helping process; and 3) examine the strategies they employed to overcome identified barriers. A total of 30 well-respected African-American women who resided in Jefferson County, Alabama participated as volunteer CHAs in the Community Retention Intervention Strategies (CRIS) project. Pre and post compliance interviews assessed CHAs' adherence to the CRIS protocol. The telephone interviews lasted for 10-15 minutes. Two-open ended questions assessed the barriers CHAs encountered and the strategies they used during the natural helping process. Post interview results revealed increases in the percentage of CHAs who reported: 1) contacting their community women 2 days before and the day of their appointment; 2) sending postcards; 3) contacting a CRIS staff member; and 4) ensuring that community women rescheduled missed appointments. Additional research findings will be discussed.

CELLUAR TELEPHONE USE AND THE NEED FOR AFFILIATION: A PRELIMINARY STUDY. Richard A. Hudiburg, Genevieve Jefcoat, and Matthew Alred, Department of Psychology, University of North Alabama, Florence, AL 35632.

Celluar telephone (cell phone) use was studied in a sample of undergraduate students (N = 119). Cell phone use was assessed with questions about type of cell phone service, amount of calls, tendencies in cell phone use behavior, and attitudes towards cell phone use issues. Measures of self-monitoring, need for affiliation, and the Big Five personality characteristics were included in the questionnaire. Descriptive statistics and correlations were computed on the responses provided by the research participants. Participants tended to have maximum daytime minute plans, made a median of 3 calls and received a median of 3 calls in a day. Cell phone users rated themselves as less likely to use their phones than their friends and rated their overall use as average. Convenience was the most common reason why the participants used cell phones. The participants were highly likely to answer calls and make calls while driving. The participants were most likely to use their cell phones while excited. The participants tended to agree that cell phone use impairs driving performance. They reported an overwhelming tendency to use their thumb in both answering and dialing cell phones. Correlation analyses revealed several interesting relationships between cell phone use behavior and self-monitoring, need for affiliation, and personality characteristics. There was the tendency for higher neuroticism with more minutes of cell phone use. High self-monitors tended to use the cell phone even when they have exceeded their daytime minutes plans. Participants who made cell phone calls immediately after and between classes tended to be higher self-monitors and seek the attention of others. High self-monitors tended to make and receive cell phone calls while driving a car.

DISPROPORTIONATE MINORITY CONFINEMENT OF JUVENILE OFFENDERS IN ALABAMA: PATTERNS AND IMPLICATIONS. William E. Osterhoff, Dept. of Justice & Public Safety, Auburn Univ. Montgomery, Montgomery, AL 36124. Carl Grafton and Anne Permaloff, Dept. of Public Administration, Auburn Univ. Montgomery, Montgomery, AL 36124.

Since the Juvenile Justice Delinquency Prevention Act was passed by Congress in 1974, several policy initiatives were targeted in an effort to improve the effectiveness and fairness of the juvenile justice system. Among the policy initiatives were deinstitutionalization of status offenders, removal of delinquents from adult jails, and requiring each state to determine the existence and extent of disproportionate minority confinement (DMC) in its juvenile justice system and to demonstrate efforts to reduce DMC where it exists.

DMC is defined as occurring when the proportion of juveniles detained or confined in secure detention facilities, secure correctional facilities, jails, and lock-ups who are members of minority groups exceeds the proportion such groups represent in the general population.

A study of DMC of juvenile offenders in Alabama, conducted for the Alabama Department of Community and Economic Affairs, utilized both quantitative and qualitative measures. The demographic composition of at-risk youth (10-17 years of age) was determined for each county from U.S. Census data. Juvenile justice processing matrices were developed based on Administrative Office of Courts data. Personal interviews were conducted with juvenile court personnel in 18 counties.

Analysis of the data indicated no overall pattern of DMC in Alabama. Detention and confinement decisions were most frequently based on the number of offenses the juvenile was charged with, court violations, and type of offense. Other predictors included gender (male), possession of a firearm, dropping out or being expelled from school, and lack of a suitable person to whom to release the youth.

**HATE AND BIAS CRIMES LAWS: MAKING HATE A CRIME.** Gloria McPherson, Department of Justice and Public Safety, Auburn University Montgomery, Montgomery, AL 36117.

As defined by the Hate Crimes Statistics Act of 1990, amended in 1994 and 1996, a hate crime is "a criminal offense against a person or property motivated in whole or in part by the offender's bias against a race, religion, disability, ethnic/national origin, or sexual orientation." Over the past decade, research shows that Americans are changing the way they respond to the issues of hate and the activities of hate groups. The activities of these mostly right-wing organizations promote hostility toward racial, religious, and sexual minorities. Because hate groups comprise only a small number of people who apparently constitute a deranged fringe of a subculture, some Americans question whether hate crimes are a serious problem or an occasional aberration. However, as reported by the Federal Bureau of Investigation in 2001, research has shown that hate crimes tend to be more violent, more traumatic to the victim, and sometimes committed by groups of perpetrators who are unknown to the victim. Whether hate crimes are an occasional aberration or not, such crimes can terrorize an entire community and, consequently, constitute serious social and law enforcement problems.

**IMPLICATIONS OF RESTORATIVE JUSTICE.** Betsy A. Witt, Dept of Criminal Justice, Columbus State University, 4225 University Ave., Columbus, GA 31907-5645.

Restorative Justice became recognized as a legitimate form of correctional treatment in the early 1990's. It was a response to frustrations with the then-current treatment programs to rehabilitate offenders, and the movement to include victims in the criminal justice process. Haired as a revolutionary form of corrections, it was expected that restorative justice would be implemented in mainly noninstitutional settings at the federal, state, and local levels. Now, a decade later, this paper examines how and where it has been utilized and the implications of this process.

**TRENDS IN TEEN SEXUAL ACTIVITY AND BIRTHS.** Janice Clifford Wittekind and Arthur S. Wilke, Dept. of Sociology, Anthropology and Social Work, Auburn University, Auburn, AL 36849.

For decades, births to 15-19 year old females in the U.S. have declined. Despite this, the topic, when portrayed as "teen-age" births often is attached to public issues or flares into a public issue in its own right. After discussing the problematic reporting frame (the category of 15-19 year olds), trends are reported. For the period 1982 to 1995, increase in sexual activity, decrease in marital status, and decline in abortions are highlighted for their contributions to the nature and type of teen-age births. Though by comparative standards the "teen-age" birth rate remains high, the data reviewed here suggests that youth may be evolving patterns of behavior not unlike those seen in the area of illicit drugs. Conjectures are offered as to why the youth are not credited for their accomplishments.

**REVISITING THE DUAL ECONOMY FORMULATION.** Arthur S. Wilke, Janice Clifford Wittekind and Shannon McKenzie, Dept. of Sociology, Anthropology and Social Work, Auburn University, Auburn, AL 36849.

The traditional sociological view of social stratification stressed that the exercise of human capital attributes (e.g., education) resulted in a unitary, graded structure of income and wealth. One of the challenges to this view was mounted by proponents (e.g., Beck, Horan, and Tolbert, 1978) of a dual economy view. This view stressed that overriding human capital and the resulting status attainment were the industrial sectors in which workers found themselves: a core with higher rewards and periphery with lesser ones. After over a generation, the work by Beck, et al., has yet to be replicated. Preliminary to such an effort is what is undertaken here: a comparative, macro analysis of positions of many of the core and periphery industries identified by Beck, et al. Over the past generation: 1) core industries continued to maintain virtually the same dominance in the in production of the Gross Domestic Product in 1999 as 1980; 2) core industries have generally have lower proportions of production workers (< 80 percent) than do periphery industries (generally > 80 percent); and 3) though hourly wages tended to decline in most industries, core production workers continue to enjoy higher hourly wages than those in the periphery though the advantages have declined through 1996. At the level reported herein, the dual economy structure seems to have many qualities suggested by Beck, et al

**WHITE COLLAR CRIME OR WHITE COAT CRIME: Health Care Fraud and Internet Pharmacy Scams.** Cheryl Bullard, Department of Justice and Public Safety, Auburn University Montgomery, Montgomery, AL 36117.

With the skyrocketing costs of health care in the United States continuing to rise, more emphasis is being placed on rooting out the fraudulent practices of unscrupulous health care providers that contribute to the overall problem. Health care providers such as hospitals and doctors who bill for services not rendered or who upcode in order to receive a higher billing may find themselves facing prosecution. Medicare fraud may be prosecuted by the federal government using such criminal statutes as the health care fraud statute, the wire fraud statute, and the mail fraud statute, as well as the civil statute known as the False Claims Act and other common law remedies. Moreover, the technology and prevalence of the internet has bred health care fraud of an entirely different nature. Due to the escalating costs of health care and the anonymity of the internet, many people have resorted to buying prescription drugs over the internet without the benefit of an examination by a physician. To combat this problem, the Federal Food, Drug, and Cosmetic Act is used to prosecute scam pharmacies. To encourage complicity of internet pharmacies and in response to public concern of the safety of pharmacy practices on the internet, the National Association of Boards of Pharmacy (NABP) offers the Verified Internet Pharmacy Practices (VIPP) seal of approval to internet pharmacies who meet specific guidelines. Whether termed white collar crime, or white coat crime, unscrupulous providers and pharmacy scam artists are a growing concern in the United States.

HEALTH SCIENCES

COPING WITH FEAR: ASSISTING NEWLY DIAGNOSED TERMINALLY DISEASED PERSONS ENCOUNTERING FEAR OF DYING. Olaf Bothe, University of Alabama School of Nursing, University of Alabama at Birmingham, Birmingham, AL, 35294-1210

Death and dying are issues rather put aside and not talked about, even in the medical community. This study examines the issue of fear as experienced by persons dying of a terminal disease. This is a qualitative descriptive study. Data will be collected in direct interviews about terminally diseased persons' fear of dying, state of acceptance, and their perception of the closing process. Subjects will be interviewed within a few weeks after being admitted to a hospice program. The goal of the study is to reveal patterns of strategies patients use or desire to overcome fear, accept, and come to a closing before dying. The relevance of the information is to help educate caregivers in end-of-life care in order to help with guidance through this most difficult process. Data collection for the study met with initial barriers in areas of census-age limitations and subject readiness to participate. These barriers are listed as preliminary results. Taking these results in consideration modifications were planned to continue the study until saturation is accomplished. Data collection is still in progress. Final results are not yet available.

CRITICAL CARE NURSES' ATTITUDES AND KNOWLEDGE RELATED TO ORGAN DONATION. Jacqueline E. Ingram and Ann Rayburn, RN, BSN, CPTC University of Alabama at Birmingham, School of Nursing, Birmingham, Alabama 35294

Recently, organ donation has become an interest to the public and health care professionals. The need for organ transplant has nearly quadrupled in the past decade, but the number of organ donors has remained relatively constant. The critical care staff is referred to as the vital link in the organ donation process. They are responsible for referring potential donor cases to an organ procurement organization, making the request for donation, responsible for the initiation of the organ donation process, and supporting the family through this process. This influence places nurses in a position to increase the supply of organs for donation. Data was collected OADQ-II from 69 critical care nurses working in private and transplant hospitals in the southeast. This study investigated the relationship of attitudes and knowledge level in critical care nurses. The study's findings suggest that nurses are favorable of organ donation, and this is correlated with their knowledge about organ ( $p = < .001$ ). The study found that the majority of nurses' had overwhelmingly positive attitudes toward organ donation, but they failed to act on their beliefs. I would like to thank all those involved who willingly gave of their time and have showed such great interest in this study. I am particularly indebted to Dr. Ellen Buckner, Stephen Hunt, RN, MSN, Linda Suther, RN, the Alabama Organ Center, Phillip Nolan, and all the nurses who participated in the study.

**CURRENT INFECTIOUS DISEASE THREATS.** Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala., Tuscaloosa, AL 35487.

Bioterrorism has been the subject of considerable discussions because of the recent anthrax attacks. Although the mortality rate from inhaled anthrax has been less than previously predicted, it still hovers around 50%. Various other infectious agents, such as smallpox, as well as toxins, e.g. botulism, are also capable of inducing high mortality. I shall discuss characteristics of agents that might be used by bioterrorists, including possible routes of transmission, incubation times, illness duration, lethality, and vaccine efficacy. My experience from receiving of the above vaccines during the Gulf War and in evaluating potential side effects in numerous vaccinees will be described, as will misconceptions concerning the use of these vaccines. Potential dangers of mass smallpox vaccination, and appropriate antibiotic use against possible anthrax exposure will also be discussed.

**EXERCISE DURING PREGNANCY: A RETROSPECTIVE LOOK AT THE FEMALE ATHLETE'S MOTIVATION AND SUPPORT SYSTEM.** Kelly M. McAfee, University of Alabama School of Nursing, University of Alabama at Birmingham, Alabama 35294-1210.

High impact activity during pregnancy is a topic that is questioned by the general public and underestimated in terms of the effects it has for the athletic woman. High impact activity includes high mileage running, swimming, biking, teaching step aerobics or a combination of these, resulting in high intensity training. The purpose of this study is to evaluate the motivation of each athlete for continuation of her activity levels throughout pregnancy and to review how her support system responded to her exercise levels. This qualitative study includes data obtained by questionnaires from 13 postpartum athletes who continued their exercise regime throughout all 3 trimesters of pregnancy. The support system (a total of 26 husbands, mothers, friends and others) also responded via questionnaire to the athlete's decision to continue exercise during gestation. Athletes reported underlying motivations such as maintenance of body image, quicker postpartum recovery, stress relief, remaining healthy and desire for easier delivery. Most support system members were supportive and encouraging although some expressed concern and anxiety. Husbands (9/13) were identified as the pregnant athlete's biggest advocate. Perceived benefits from exercise were numerous and varied, and all athletes reported exercise having a positive effect on labor and/or the recovery period.

**METHYLATION INHIBITION BY PERIODATE-OXIDIZED ADENOSINE ENHANCES ARSENIC DEVELOPMENTAL TOXICITY IN MICE.** Carol A. Lammon, Capstone College of Nursing, & Ronald D. Hood, Dept. of Biological Sciences, University of Alabama, Tuscaloosa, AL 35487.

Inorganic arsenic, given by injection to pregnant laboratory animals, can induce malformations. Arsenic methylation, which appears to be a detoxification step with respect to toxicity and teratogenicity, can be inhibited by periodate-oxidized adenosine (PAD). Severe human health effects from chronic arsenic exposure have mainly been reported in populations with significant levels of malnutrition, which may compromise arsenic methylating capacity. Our study sought to determine the effect of inhibition of arsenic methylation on the developmental toxicity of arsenic. PAD (100  $\mu$ M/kg, ip) was given to pregnant CD-1 strain mice 30 min prior to 7.5 mg/kg sodium arsenite [As(III)], ip, or 17.9 mg/kg sodium arsenate [As(V)], ip, on gestation day (GD) 8 (plug = GD 0). Control dams received As(III), As(V), or PAD alone or were untreated. Dams were killed on GD 17, and their litters were examined for mortality and gross and skeletal defects. Pretreatment with PAD prior to either arsenical resulted in increased maternal toxicity, lower fetal weights, and higher prenatal mortality. Significant increases in the incidences of exencephaly, ablepharia, and anomalies of the vertebral centra, sternbrae, and ribs were also caused by PAD pretreatment. These results demonstrate that the developmental toxicity of inorganic arsenic can be enhanced by PAD, possibly due to inhibited methylation of arsenic. Supported in part by a grant from Sigma Theta Tau International, Epsilon Omega chapter.

**NUTRITIONAL ASSESSMENT IN HOSPITALIZED PATIENTS.** Mary E. Green, L. Ferguson, K. Logan, J. Roy, S. Gaskins, J. Lipscomb, B. Wilhite, S. Copeland, M.A. Murdock, R. E. Pieroni, DCH Regional Medical Center, Tuscaloosa, AL 35401.

Malnutrition, unfortunately, still occurs, all too frequently in both acute- and long-term care facilities and is related to increased morbidity and mortality. Since prevention is paramount, assessment of early markers of nutritional status continues to be extremely important. Prealbumin (PA), a negative phase transport protein, has been shown to be a sensitive and early indicator of the adequacy of nutritional support. However, its levels are affected by acute phase reactions such as sepsis and a variety of pathological and inflammatory states. Since C-Reactive Protein (CRP) increases during stressful conditions, a negative correlation between PA and CRP would be expected. We evaluated results of sequential monitoring of both PA and CRP in over 300 patients receiving parental nutrition for an average of 12 days. Such measurements were found to be extremely helpful in assessing adequacy of nutritional support, and in interpreting non-rising PA levels, especially during septic states. The results demonstrated that monitoring PA and CRP offers the practitioner an additional marker for assessing effectiveness of nutritional support—an area of vital concern for all health care providers.



**PAIN PERCEPTION IN NURSING HOME PATIENTS.** Robert E. Pieroni, Dept. of Internal Medicine, Univ. of Ala, Tuscaloosa, AL 35487.

In both acute- and long-term care facilities pain is frequently unaddressed, undocumented and unrelieved. This is especially true of older, demented patients who can experience pain from a variety of sources. Management of pain is an important indication of a facility's quality of care. Demented patients often display markedly atypical pain behaviors which may be unrecognized by inexperienced and/or inadequately trained health care workers. Untreated pain can result in physical and mental alterations through a variety of mechanisms involving numerous organ systems. It can also result in considerable increase in morbidity and even mortality. I shall discuss common myths concerning pain control especially the frequently unwarranted concern about addiction from the use of narcotic analgesics. Pain assessment tools, such as the "Assessment of Discomfort in Dementia" (ADD) protocol will be discussed, as will appropriate measures to alleviate, to the extent possible, pain and discomfort in patients who frequently cannot verbalize extremely painful situations.

**THE RELATIONSHIP BETWEEN SELECTED VARIABLES AND EXERCISE PARTICIPATION IN FIREFIGHTERS IN BIRMINGHAM, ALABAMA** Yothaka Pakapong and Michael Weaver  
Sch Nursing, Univ of Ala, Birmingham, 35205. James Hilyer, The Birmingham, Fitness Center, Birmingham, AL, 35205.

The benefits of exercise have been widely recognized. However, only 20% of people in the United States exercise regularly. Physical fitness is essential for firefighters to perform required job tasks and reduce risk for chronic diseases and workplace injury (Hilyer, et al 1999, Sorensen, 2000; Weaver, et al, 2001). Regular exercise at moderate intensity for 30 min/session at least 3 days a week can enhance and improve physical and mental fitness. Many studies have examined factors that influence exercise participation, but few studies have specifically examined firefighters. This study sought to determine the relationship between a set of demographic and Theory of Reasoned Action (TRA) – derived variables and exercise behaviors in firefighters in Birmingham, Alabama.

This study used a non-experimental, correlational design with a convenience sample of 246 participants. All participants completed a questionnaire containing questions about demographics, exercise behaviors, attitudes, subjective norms, and intention to exercise. Correlation analysis was used to test the relationship between exercise participation and selected TRA and demographic variables. The results of this study suggest that Age, Physical Health, Attitude, & Intention have a significant positive relationship with exercise participation. However, only a small amount of exercise behavior variability was explained by each variable. Further study incorporating (a) a multi-variable approach, (b) variables in addition to those in the TRA, or (c) use of a different theoretical framework may produce higher levels of explanation. In addition, examination of these associations in a more heterogeneous sample may result in improved explanatory power.

**SCHOOL SCREENING OF SCOLIOSIS: ARE THE COSTS JUSTIFIED?** Tom E. Denton, Dept. of Biology, Auburn University at Montgomery, Montgomery, AL 37117.

The U.S. Preventive Services Task Force released its findings almost 10 years ago concerning the disadvantages of school screening for scoliosis. Reliability, predictability, and costs of screening procedures were challenged. The American Academy of Pediatrics, The American Academy of Orthopedic Surgeons, and the Scoliosis Research Society have refuted many of the USPSTG interpretations. Screening costs are difficult to determine because of the various methods used by any of the 33 states that require annual examination of school children. The Adams forward bending test is the simplest screening method and it is also the most economical. Costs amount to pennies per student because trained health nurses or physical education personnel can complete tests and transmit results for hundreds of students in less than a day. However, this method is also the least accurate. Costs escalate as technological procedures are used to improve reliability. Moire analysis and radiology can cost up to \$60 per child. Radiology constitutes the gold standard of methods but these tests are both invasive and potentially harmful. This lack of a low cost and reliable scoliosis screening standard speaks to the problems cited by the USPSTG. In the meantime, the Adams test should not be abandoned. Without economical school screening, many children, especially those from low income families, will be disadvantaged by not having examinations during a time when their spines are undergoing rapid developmental changes.

**TEACHING INTERNAL MEDICINE: A RURAL PRECEPTORSHIP.** E. Ray Stewart, John R. Wheat, M.D., MPH, Robert E. Pieroni, M.D. The University of Alabama Department of Rural and Community Medicine, Tuscaloosa, AL.

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Throughout the state of Alabama, there are a considerable number of medically underserved communities. The lack of physician access, locations of hospitals, and geographical isolation all play major roles in creating this situation. The University of Alabama in conjunction with the University of Alabama at Birmingham (UAB) has developed a number of programs designed to infuse primary care physicians into rural and underserved areas of the state. For the most part, each of these programs focuses primarily on training family practice physicians. Family practice is a valuable, much needed component of primary care in rural areas. However, the programs in place need to be expanded to address the lack of internists in underserved areas. Rather than developing a new method of training students in rural internal medicine, it was decided that existing programs should be reviewed. The review was conducted through a literature search, personal interviews and e-mail. In addition, it is important to garner an understanding of the rural communities in the state of Alabama to determine possible sites of community-based training. Through the knowledge gained from program reviews, it will be possible to address the issues and concerns surrounding the development of a rural internal medicine preceptorship for the state of Alabama.

**THROMBOCYTOPENIA AND IRON DEFICIENCY ANEMIA IN A YOUNG MALE: AN UNUSUAL PRESENTATION.** Salih Faldon, Robert E. Pieroni Internal Medicine, Univ. of Ala., Tuscaloosa, AL 35487.

A 23-year-old male with a past history of "blood not clotting properly" presented to our emergency department (ED) with complaints of sinusitis and epistaxis. His hemoglobin and platelets were decreased; other coagulation studies were normal. Available records indicated that he had experienced several bleeding episodes requiring RBC and platelet transfusions. Bleeding was first noticed after circumcision and he was diagnosed as having "Glanzmann's syndrome" which is a thrombasthenia ("weak clot") in which the bleeding time is prolonged because platelets fail to aggregate properly due to of a platelet membrane defect. Unlike our patient, the platelet count is usually normal. Shortly after his initial ED visit the patient bleed profusely. Hemoglobin decreased from 7.2 to 4.9 and he required immediate transfusion of 3 units of packed cells. The bleeding was felt secondary to erosive gastritis for which he was treated. In view of his marked iron deficiency he was placed on parenteral iron. Several published reports indicate that severe iron depletion can lead to thrombocytopenia, which we feel explains the atypical nature of his Glanzmann's syndrome, i.e. both qualitative and quantitative platelet abnormalities.

**VIDEOGRAPHY IN THE CLASSROOM: INCORPORATING ONE'S OWN RESEARCH INTO TEACHING.** *M. Peggy Hays*, College of Nursing, Univ. of Ala., Huntsville, AL 35899.

Nurses at every level need to speak with knowledge, confidence, and poise. The ability to communicate in a manner that influences others to achieve goals is key to personal and professional success. In today's expanded role of nurse managers (NM) and chief nurse executives (CNE), the ability to manage across disciplines is critical. As primary spokespersons for clinical practice, the NM and CNE must communicate at the conference table with multidisciplinary teams to establish collaborative relationships and foster shared outcome accountability. My teaching strategy of video recording student presentations in nursing administration graduate courses is a result of my studies of shift reports videotaped in the clinical setting. These studies indicate that specific behaviors either promote or hinder information exchange and a collegial environment. The framework for this teaching approach is Chinn's art of criticism, that is, the use of feedback to impart positive messages that provide an interpretation to the other or the self of which the person(s) may not have been aware. The classroom videotaping of students' presentations is done in conjunction with self-assessments of their verbal and nonverbal behaviors in sequential courses. This method provides formative and summative benchmarks for the instructor and students. During the courses and following graduation, students have found that videography is a helpful educational intervention, noting that it lets them see where they need to modify their actual behavior patterns to achieve the behavior standards they set for themselves.

ENGINEERING AND COMPUTER SCIENCE

ADAPTABLE WEB SERVICES. Song Zhou, Deptment of Computer and Information Sciences, University of Alabama At Birmingham, Birmingham, AL 35294-1170

Web services are becoming one of the mostly influential technologies for developing heterogeneous distributed applications. So it is valuable to create an adaptable web service, which can be reconfigured as the environment changes. This can be achieved by utilizing the generative programming technique and the extensibility provided by the Web Service Description Language (WSDL). In WSDL, an interface is defined in three steps. Firstly, we define the abstract interface, or "port type." Then the port type is bound to a specific message format and transmission protocol into a "binding." Finally, the binding is bound to a specific address into a concrete interface, or "port." Several ports are organized into a web service. To make a web service adaptable, we can define a meta port type for reflection, which will be supported by all the web services that are to be adaptable. All user-visible variation points will be exposed as available operations. The meta port type will provide the operation to query those predefined operations. Interfaces can be defined or redefined by composing those operations. It will also provide the operations for specifying the desired message format and transmission protocol. Additional operations can be defined for supporting the user-transparent variation points, such as tuning the performance, setting the security level, etc.

AGENT COMPUTING CAPABILITIES. Francisco Hernandez Dept. of Computer Science, Univ. of Alabama at Birmingham, AL 35205.

Intelligent agents have received new impetus in computing due in part to progress in hardware and software. Trying to provide a rigorous definition of "intelligent agent" that all can agree upon has proved elusive. It is typical, therefore, to define the notion via a list of attributes or as a collection of capabilities. One highly important (agent) capability is the ability to initiate a process without specifically being requested to do so by a user or another agent. This capability is called "proactivity" (or "pro-activeness"). Another capability related to proactivity is the ability to operate without human intervention. This capability receives the name of "Autonomy".

FILTRATION MEDIA FOR REMOVAL OF METALS FROM URBAN STORMWATER RUNOFF: LAB-SCALE EVALUATION. Sarah Gill, Pauline Johnson, and Robert Pitt, Dept. of Civil and Environmental Engineering, Univ. of Ala., Tuscaloosa, AL 35487.

The objective of this work was to examine and compare several potential filter media to determine the advantages and disadvantages of each media for removing metals from urban runoff and reach a conclusion as to which media have the best potential for use in filter applications. The uptake of copper, cadmium, zinc, lead, chromium and iron by several media (sand, peat-sand, composted leaves, cotton mill waste, activated carbon, commercial ion-exchange resin, agrofiber, iron-oxide coated sand, 2 zeolites, kudzu, and peanut hulls) was investigated. Capacity data, uptake ability at low metal concentrations, and rate of uptake data were obtained with isotherm and kinetic investigations under steady state batch equilibrium conditions. Leaching of metals from the various media was also examined. This data allowed comparisons to be made between the media and help in selecting the media that had the best potential for success in the column studies. The final media selected were peat-sand, compost and zeolite. These media are currently being examined further using lab-scale filter columns to both compare the effectiveness of the different media and to examine the impact of design factors, such as flow rate, on filter efficiency.

Application of Formal Methods in Distributed Computing\*. Chunmin Yang, Dept. of Computer and Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294. [yangc@cis.uab.edu](mailto:yangc@cis.uab.edu)

Component-based software development is a promising solution for Distributed Computing. We use formal methods to formalize the integration of software in a heterogeneous distributed environment. Formal specifications provide abstract and precise descriptions of system behavior and properties, and may be used to represent the functional and non-functional properties (also called Quality of Service or QoS parameters) of the distributed system. We propose the formal method in the form of a class to represent the effect of non-functional actions on non-functional attributes. Members of the class include the non-functional attributes, the actions performed on the attributes, and properties constraining the actions on the attributes. This class also defines the correlated attributes with a very high level of abstraction, totally independent of the low-level hardware or software. Two-Level Grammar (TLG) is the formal specification language for this purpose. The two levels define the set of type domains and the set of function definitions operating on them, and are used to represent non-functional attributes and non-functional actions performed on these attributes, thus representing the QoS requirements. TLG type definitions allow multiple attributes to be defined in a class, which is needed for QoS attributes. Multiple function signatures in one class are similar to multiple actions affecting one attribute.

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GENERATIVE ASSEMBLY OF DISTRIBUTED AND HETEROGENEOUS COMPONENTS\*. Wei Zhao, Dept. of Computer & Information Sciences, The University of Alabama at Birmingham, Birmingham, AL. USA 35294. zhaow@cis.uab.edu

Product line architecture has provided a large productivity gain for manufactures for the last 200 years, while software engineering is still in the infancy of handcrafting. To achieve the goal of software engineering productivity, we adopt a Unified Meta-component Model (UMM) to formally specify the distributed and heterogeneous components in order for them to be interchangeable parts and be configured to be plugged into different software products. Heterogeneous components along with their UMM specifications are developed by different developers and are deployed over the Internet subject to the discovering by Headhunters (HH). After components have been fetched by HH, the main task of the system is to seamlessly assemble the components into the final system. The generation rules based on Generative Domain-specific Models (GDM) for glue and wrapper code are embedded in UMM and represented in Two-Level Grammar (TLG). During assembly, non-functional Quality-of-Service (QoS) provided by components is another concern that is to ensure the released system has the expected or better characteristics. QoS parameters are also embedded in UMM and written in TLG. If the system assembly succeeds, a new set of UMM specifications will be generated as well so that the new system can act as a component of other applications further along the product line.

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LOCATING HETEROGENEOUS DISTRIBUTED COMPONENTS USING HEADHUNTERS \*. Fei Cao, Dept. of Computer & Information Sciences, The University of Alabama at Birmingham, Birmingham, AL. USA 35294. caof@cis.uab.edu

The distributed computing systems, which are and will be widely adopted both in the civilian and military sectors, require the development of robust, effective software based on heterogeneous components. Through public interface and private implementation, the independently developed components are expected to be integrated together to realize distributed computing systems, which should satisfy not only the functional requirements, but also the nonfunctional requirements. We have proposed a framework for assembling software systems from distributed heterogeneous components, which is based on the notions of a meta-component model, a generative domain model, and specification of appropriate QoS parameters. In this model, a special component head-hunter is adopted to search for distributed, heterogeneous components and to register their functionality and attempt matching between client and server components. We have implemented a prototype level example in the Voyager environment realizing the mobile search of components. Component information is registered leveraging the Voyager ORB's federated distributed naming service.

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MATHEMATICAL MODELS IN DYNAMIC LOAD-BALANCING FOR CLUSTER COMPUTING. Yibing Wang, Department of Computer & Information Sciences, University of Alabama at Birmingham, Birmingham, AL 35294.

Dynamic load-balancing helps achieving high-performance in cluster computing by keeping overall system workload "evenly" distributed at run-time. Theoretically, optimal load-balancing (both static and dynamic) is a *NP-Complete* problem. Practically, many sub-optimal solutions exist. Because earlier practices in dynamic load-balancing are empirical in nature, it is not easy to evaluate which is better. Modern approaches employ concrete mathematical models, therefore, are analytical. We first illustrate a few of those models as well as their limitations in real settings, then focus on a group of four algorithms as the framework for decentralized dynamic load-balancing. Some of those algorithms had been used in different cases by different researchers. We are the first to integrate them after a careful investigation of the problems in decentralized dynamic load-balancing. We study in those algorithms the mathematics, which includes probability theory, differential equations, stochastic processes, and queue theory, thus to have a clear view of the algorithms' strength and expected performance.

QUALITY CONTROL EVALUATION FOR THE NATIONAL STORMWATER BMP DATABASE. Alexander A. Maestre, Robert Pitt. Dept. of Civil and Environmental Engineering, University of Alabama, Tuscaloosa, AL 35487.

The ASCE's National Stormwater BMP Database is gathering information from many stormwater control evaluation studies from throughout the world. The purpose of this database is to compare the actual performance of the controls with different site and design conditions. Some of the evaluation studies are several decades old, while others have just been completed. There is therefore a large variation in the types of information collected and in the format of the data. This presentation will describe the problems encountered in data verification associated with preparing data for submittal from many widely different studies. These problems may be similar to those we expect to encounter during our current EPA-funded project where we are compiling and evaluating the Phase I NPDES stormwater program data.

## PATTEN RECOGNITION FOR SET OF CLUSTERING POINTS

Xidong Zheng, Dept. of Computer and Info. Science, Univ. of Ala. At Birmingham

In my project, First, I generated a set of random sample points (using mouse clicking or reading from a existing file). Secondly, I computed the mean and covariance of these points and also constructed the covariance matrix of a given sample points set. Next, using Jacobi orthogonal transforming method, I eigenanalysed this matrix to compute its eigenvectors and eigenvalues. Then, From Duda and Hart's reference, I deduced the length of each principal axis of the ellipse according to the sample points and computed them. We already know that the center of the ellipse is the mean vector of the sample points, and direction of each principal axis of the ellipse is the eigenvector of the covariance matrix. Last I have drawn out this ellipse on the screen.

## SEQUENTIAL EXTRACTION AND PARTICLE SIZE ASSOCIATIONS OF STORMWATER POLLUTANTS. Rence E. Morquecho and Robert Pitt, Dept. of Civil and Environ. Eng., Univ. of Ala., Tuscaloosa, AL 35487-0205.

Pollutants in urban runoff are a major contributor to the degradation of urban streams and rivers. An important characteristic affecting the treatability and fate of many pollutants is their association with different particle sizes. This project investigated the association of nutrients, toxicity, pH, chemical oxygen demand, and turbidity with particle size. In addition, trace metal associations with particulates in stormwater was also examined. Results show that total phosphorus and phosphate are associated with the particulates in stormwater while other nutrients such as nitrate are dissolved and their concentration is not effectively reduced by a reduction in particle size. Most of the stormwater samples contained particulates less than 20 microns in size and a few samples contained over fifty-percent particulates as dissolved solids. In contrast to our earlier tests, toxicity did not seem to be associated with the particulates during these tests, but these results were questionable because quality control samples returned wide-ranging results. Preliminary results from trace metal associations showed that significant reductions in the metal concentrations are associated with screening with finer sieves and filters. However, we expect that the metal concentrations associated with the smaller particles (expressed as mg metal/kg solids) will be much greater than for the larger particulates. These results also indicate that 2 to 5  $\mu\text{m}$  particle control is likely needed to obtain the lowest metal concentrations achievable by filtration or sedimentation, and these reductions are significant, especially for the largest concentrations found. Removal goals associated with larger particles will likely be ineffective. Analysis of trace metal data is ongoing and additional stormwater samples will be collected.



BIOINFORMATIC APPLICATIONS OF HIDDEN MARKOV MODELS. Jeremy Fisher, Dept. of Computer and Information Sciences, UAB, Birmingham, AL 35294.

The growing field of bioinformatics is one that combines computer science, statistics and molecular biology. A tool widely used in bioinformatics is Hidden Markov Models. A Hidden Markov Model (HMM) is a stochastic Finite State Machine, a tool that has been used for speech recognition in the past. Hidden Markov Models have proved useful for many problems in the domain of molecular biology and have been applied to a variety of problems, and are particularly useful in linear sequence analysis of proteins.

VEGETAL RETARDANCE IN GRASS SWALES USED FOR THE REMEDIATION OF URBAN RUNOFF. Jason T. Kirby and Dr. Robert E. Pitt, Dept. of Civil and Environmental Eng., Univ. of Ala., Tuscaloosa, AL 35487.

Recent studies have identified metals in urban runoff as a major contributor to the degradation of urban streams and rivers. Grass swales have previously been demonstrated as an effective medium for the reduction of metal concentrations. The swales control heavy metal contamination through a combination of sedimentation, infiltration, and biological uptake. Known effectiveness, in conjunction with low operating costs and application flexibility, have made further study of grass swales attractive. The objectives of the research in progress are 1) To develop a method by which the hydraulic characteristics (specifically, Manning's "n") of shallow open channel flow in a swale can be predicted on the basis of flow rate, channel cross sectional geometry, slope, and grass type and 2) To develop a method by which the metal removal rates can be predicted when the hydraulic characteristics, flow rate, channel cross sectional geometry, slope, and grass type are specified. Determination of Manning's "n" is accomplished by the detailed survey of multiple flow profiles resulting from manipulation of parameters in laboratory swales. The calculated results are then plotted as Manning's "n" vs. the product of Velocity and Hydraulic Radius ( $V \cdot R$ ) to show the degrees of vegetal retardance.

Stringent regulation of metals in urban runoff will be a reality in the near future. This investigation will enhance our understanding of the fate and transport of metals through grass swales. Research results will therefore aid in more effective implementation of this low cost control technology for metals in urban runoff.

THE USE OF MACHINE-GENERATED ONTOLOGIES IN DYNAMIC INFORMATION SEEKING. Giovanni Modica, Hasan Jamil, Dept. of Computer Science, Mississippi State University, MS 39762, and Avigdor Gal, MSIS Department, Rutgers University, NJ 08854

Business enterprises depend on eCommerce applications to gain advantage of the Internet market. One of the technologies these applications rely on heavily is the creation and maintenance of ontologies. Ontologies capture the structure, relationships, semantics and other essential meta information about the application. Although some standard ontologies are emerging for effective business to business interaction, companies typically use and need unique ontologies to suit their business needs, causing enormous difficulties for autonomous agents trying to interoperate among heterogeneous information sources. This work describes how to automate application interoperability by using dynamically created ontologies. We propose a set of techniques and heuristics to extract ontologies from data accessible on the web in the form of semi-structured HTML pages. Ontologies retrieved from similar applications are merged together to create a general ontology describing the application domain. Information-retrieval metrics are used to measure the usefulness of the ontologies created.

XML AND DAML FOR CONTEXTUAL KNOWLEDGE REPRESENTATION OF NATURAL LANGUAGE REQUIREMENTS DOCUMENTS \*. Beum-Seuk Lee, Dept. of Computer & information Sciences The University of Alabama at Birmingham Birmingham, AL. US 35294. leeb@cis.uab.edu

In software engineering a system requirements document written in a natural language (NL) needs to be translated into one of the formal specification languages for system execution. When this translation is to be automated, resolution of the ambiguity in the document and explicit definition of implicit domain knowledge are necessary. In our approach, Contextual Natural Language Processing is used to overcome the ambiguity and the domain knowledge is expressed in DARPA Agent Markup Language (DAML). In addition, a knowledge base and Two-Level Grammar (TLG) are used as intermediate representations in the translation. A precise yet expressive knowledge representation is formalized which captures syntactic and contextual information of the requirements. TLG is chosen to construct a bridge between an informal NL requirements specification and a formal specification (in our case the Vienna Development Method - VDM) because it provides not only flexibility with its mostly NL-like syntax and also appropriate formalism. The result is a formal representation of the informal requirements in NL for prototyping and even for implementation.

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ANTHROPOLOGY

BATTLE OF TALLLASEEHATCHEE: ALABAMA IN THE WAR OF 1812. Harry O. Holstein, Department of Geography and Anthropology, Jacksonville State University, Jacksonville, AL 36265. Phillip E. Koerper, Department of History and Foreign Language, Jacksonville State University, Jacksonville, AL 36265. Brigitte F. Cole, Department of History and Social Sciences, Benedict College, Columbia, SC 29204.

On November 3, 1813, one thousand militiamen under the command of General John Coffee attacked a Red Stick Creek Indian village. In the course of the battle, 186 Creek Indians and five Tennessee militiamen were killed. Archaeological and historical research indicates the archaeological site of 1Ca162, near Alexandria, Alabama, is the location of this major military encounter in the War of 1812. Extensive historical research provided new insight into the battle's participants while generating significant topographic data. Archaeological research resulted in the recovery of sufficient 19<sup>th</sup> century Creek and military artifacts to warrant 1Ca162 as the best candidate for the Battle of Tallasseehatchee.

THE DOMESTICATION OF THE DOG IN GENERAL--AND DOG BURIAL RESEARCH IN THE SOUTHEASTERN UNITED STATES. Brigitte F. Cole, Department of History and Social Sciences, Benedict College, Columbia, SC 29204. Phillip E. Koerper, Department of History and Foreign Languages, Jacksonville State University, Jacksonville, AL 36265.

Several problems concerning the domestication of the dog have challenged anthropologists for decades. The previously accepted views of the dog's origins, method of domestication and approximate evolutionary dates are now being challenged by new scientific methods such as mitochondrial DNA. A much earlier date for the appearance of the dog could provide new approaches to assessing archaeological data. This paper concludes by examining selective dog burials in the southeastern United States and the conclusions of several anthropologists.

TOLBERT FARM, A LATE PALEO-EARLY ARCHAIC SITE COMPLEX NEAR JACKSONVILLE, ALABAMA. Harry O. Holstein, Department of Geography and Anthropology, Jacksonville State University, Jacksonville, AL 36265. Phillip E. Koerper, Department of History and Foreign Language, Jacksonville State University, Jacksonville, AL 36265, and Brigitte F. Cole, Department of History and Social Sciences, Benedict College, Columbia, SC 29204.

The Tolbert Farm Complex is located along a tributary branch of Tallassee hatchee Creek. These sites are of interest for two reasons: one, the diversity and density of late Paleo/Early Archaic bifaces recovered from the complex as compared to other regional archaic sites; and two, the fact that these sites lie nearly twenty miles east of the Coosa River along a small tributary branch. Researchers believe the geographical location of the Tolbert farm complex along little Tallassee hatchee creek, whose headwaters originate in White's Gap providing a major east/west entry across Choccolocco Mountain, may explain the presence of this prolific early site complex.

The following three abstracts are of papers presented in the Health Sciences Section of the Alabama Academy of Science at its 78<sup>th</sup> annual meeting at Auburn University, March 28-31, 2001. The editor regrets their inadvertent omission from the abstract volume for that meeting.

**AN UNUSUAL CASE OF SEVERE JAUNDICE.** Terri Gottstine, Robert E. Pironi, M.D. The University of Alabama School of Medicine. Tuscaloosa Program.

We present the case of a 68 yr old homeless African American male who presented to our E.D. after being found unresponsive. No past history was obtainable. The patient was febrile, bradycardic, hypotensive, edematous, and markedly jaundiced. He presented with electrolyte abnormalities, as well as notable elevations in his liver function tests with a serum bilirubin of 23, and serum ALP of greater than 2000--one of our lab's highest values in years. HIV testing was negative. CT and x-ray findings revealed cardiac and liver enlargement with pleural effusions and ascites. Despite vigorous attempts to correct the patient's multiple medical problems, he developed a massive GI bleed and expired 5 days after admission. The differential diagnosis of the patient's severe liver disease and multi-organ involvement was discussed in detail and included granulomatous disease, such as mycobacterial infection. A liver biopsy was planned but was not done because of the patient's severely deteriorating condition. However, permission for an autopsy was granted. This revealed miliary tuberculosis with diffuse granulomatous disease, caseation necrosis, and acid fast organisms identified at multi-organ sites including the liver, lungs, kidneys and adrenal glands. We shall discuss in detail the differential diagnosis, risk factors, classification, and other germane factors associated with miliary tuberculosis, especially as related to this patient. The value of autopsies, although extremely under-utilized, will be emphasized.

**APPROPRIATE ANTICOAGULATION THERAPY.** Nada Memon, Robert E. Pironi, The University of Alabama School of Medicine, Tuscaloosa Program.

The use of anticoagulants, such as heparin and warfarin, has drastically reduced morbidity and mortality from thrombotic disorders, such as pulmonary embolism, and acute cerebral and coronary events. These medications can have severe side effects, especially if not carefully monitored. Recently, low molecular weight heparin (LMWH) has been found to be effective in a variety of conditions with some less side effects and need for monitoring than unfractionated heparin. Warfarin levels can be affected by numerous medications, foods and physical conditions with resulting excessive or diminished coagulation. We shall discuss in detail methods for prudent use of anticoagulants in order to avoid either increased bleeding or perpetuation of thrombotic events. Appropriate patient selection for anticoagulation will be underscored.

THE CLINICAL SPECTRUM OF LEAD TOXICITY. Kristopher W. Cummings, Robert E. Pieroni. The University of Alabama School of Medicine, Tuscaloosa Program.

While the frequency of lead poisoning in the U.S. has decreased in recent years secondary to decreased use of lead-containing paints and gasoline, all too many individuals are exposed to toxic levels. Toxicity may result from exterior lead paint, contaminated drinking water, moon shine, and jobs involving work with storage batteries, welding, ship building and paint manufacturing. Lead exerts its toxic effect by interfering with several key enzymes. In order to recognize lead intoxication, one must have a high degree of clinical suspicion and be familiar with the broad range of clinical manifestations, which can involve virtually any body system. Lead especially affects the hematological, gastrointestinal, and nervous systems. A panoply of manifestations ranging from microcytic anemia, abdominal pain, seizures, and even death may ensue. Peripheral nervous system findings in plumbism may include wrist and foot drop especially in adults. Other effects include interstitial nephritis, saturnine gout, and hypertension. Health care workers must combine knowledge of potential methods of exposure, as well as historical, physical and laboratory information in order to provide appropriate care for patients with lead poisoning. Methods of diagnosis and treatment in both children and adults will be discussed in detail.

Alabama Academy of Science Symposium, 2002  
"Alabama's Geological History"  
Annual Meeting, University of West Alabama

**HISTORICAL GEOLOGY OF ALABAMA: THE PAPERS OF MICHAEL TUOMEY.** Lewis S. Dean, Geological Survey of Alabama.

The compiled extant papers, including correspondence, consulting reports, research papers, legislative reports, and newspaper articles of Michael Tuomey (1805 - 1857) provide an excellent source on the significance of early geologic mapping, economic geology, and paleontology research in Alabama. Tuomey, a native of County Cork Ireland, immigrated to the U.S. in 1833 and graduated in 1835 from Rensselaer School in Troy, New York. By 1841 Tuomey had moved to Petersburg, Va., and began a long-standing correspondence regarding scientific research in the south while actively involved in the wide-ranging scientific activity of contemporary naturalists. Tuomey's state-supported studies of southern geology were initiated in 1844 in South Carolina with his appointment as state geologist. The University of Alabama invited Tuomey to fill the newly established chair of geology, mineralogy, and agricultural chemistry in 1847. Soon after Tuomey had begun his field work toward the first systematic geological survey of the state. While working on the Alabama survey, Tuomey had numerous letters of progress published in local newspapers which contain a great deal of geologic information not in his official reports. This material provides excellent examples of geological field observations made as the initial effort of a state geological survey. Tuomey provided some of the first detailed descriptions of several classic geologic localities in Alabama. The efforts and results of Tuomey's scientific work were recognized by his contemporaries who knew the trials of geologic investigations in the antebellum south, and by subsequent workers who could appreciate Tuomey's contributions in a wide range of geologic endeavors.

**LOST WORLDS IN ALABAMA ROCKS: A NEW PERSPECTIVE ON THE STATE'S GEOLOGIC HISTORY.** Jim Lacefield, University of North Alabama and CEO of PaleoAlabama.

Alabama's present landscape and biological communities are the products of a long and dynamic past that has recently become more understandable through new interpretations of the state's geologic record. The state's rocks constitute one of the most complete and informative geologic records of any part of North America. A robust body of geologic data accumulated through more than a century of mapping and correlation of Alabama's surface rocks combined with new information compiled from deep drilling for petroleum and natural gas during the past several decades has produced a 3-dimensional picture of the state's geology that provides insight into how the land has evolved through the last 500 million years. Alabama rocks contain sedimentary and structural clues that reflect the significant tectonic events that have shaped the southern margin of North America, including the removal by rifting of the Argentine Precordillera during Cambrian times, the thrusting, faulting, and sedimentation accompanying the assembly of Pangaea along the Suwannee-Wiggins Suture zone during the late Paleozoic Era, and the rifting dynamics that created the Gulf of Mexico during the breakup of Pangaea in the early part of the Mesozoic Era. In addition, a significant body of paleontological evidence gives clues to how the state's biota has evolved in conjunction with contemporaneous changes in landscape mode, climate, and local environment through the last half-billion years of time. An awareness of this rich history contained in the geologic record can provide a useful context for understanding the land of Alabama and its living systems even in the present day.

## GEOLOGIC HISTORY OF ALABAMA'S RIVER SYSTEMS.

Andrew K. Rindsberg, Geological Survey of Alabama.

Alabama's rivers have a high degree of endemism that can be attributed in part to long separation of drainage basins. However, the riverine faunas are also interrelated in ways that suggest that the river systems have been connected at times.

The geologic record sheds some light on this problem. Based on stratigraphy and geomorphology, the upland basins of the Chattahoochee, Coosa, Cahaba, Black Warrior, and middle Tennessee Rivers were already established by the Late Cretaceous sea-level highstand. As the shore receded, rivers extended themselves across the Coastal Plain and some may have interconnected in the Paleocene and Eocene before the next extreme highstand in the Oligocene. The Oligocene highstand isolated the upland basins from one another and greatly reduced the river systems' area, presumably leading to high rates of extinction and speciation. During the Tertiary, upland basins were probably repeatedly filled with alluvium and then exhumed, shifting between soft and hard bottoms. Only a few streams at high elevations, such as Talladega Creek, could have maintained relatively constant conditions.

Unusually extensive alluviation during the Miocene may have allowed rivers to wander out of their usual basins before becoming reestablished; notably, the Tennessee River may have drained across the Warrior basin into Mississippi. During the Pliocene, the Alabama and Tombigbee Rivers greatly expanded their drainage basins. When the Alabama captured the Cahaba and Coosa Rivers, all these diverse faunas intermingled – and simultaneously the lower courses of the captured rivers in southeastern Alabama were isolated. During the Pleistocene, the major rivers eroded downward about 200 to 250 feet, making the Black Belt into a trough and scooping out the upland basins once again.

## GETTING OUR FEET WET: ANCIENT ALABAMA REEFS.

David C. Kopaska-Merkel, Geological Survey of Alabama.

Many of Alabama's ancient rocks and sediments contain fossil reefs or mounds, ecologically similar to oyster reefs in modern Mobile Bay. Three examples of these ancient buildups are described.

Upper Ordovician mounds in the Alabama Appalachians are dominated by bryozoans and algae, with bachiopods and sponges important in some mounds. The bioherms are constructed of bafflestones and boundstones and fine internal sediment.

The Mississippian Bangor Limestone, deposited on a broad platform that stretched across north Alabama, contains carbonate buildups that grew on topographic highs. A mound in Lawrence County consists chiefly of packstone and grainstone dominated by echinoderm ossicles and fragments of fenestrate bryozoans. In situ colonies of the rugose coral *Caninia flaccida* compose about 8 percent of the mound by volume. Strong currents within the mound are indicated by preferred orientation of corals and by coarse, commonly cross-stratified grainstone in channels between neighboring coral colonies. Corals are most abundant on the windward side of the mound.

Carbonate mounds flourished in the Upper Jurassic Smackover Formation on the 65-kilometer-long Saint Stephens ridge. The ridge crest, up to 15 kilometers wide, supported distinct communities of mound builders, which constructed different kinds of mounds. On the southeastern ridge flank, a biodetrital mound is dominated by locally derived debris. The mound incorporated microherms up to 1 meter thick, which account for 16 percent of the mound. On the northern part of the ridge crest a similar microherm-bearing mound 8.5 meters thick is directly overlain by a microbial mound 9 meters thick. The microbial mound consists of stromatolite and of thrombolite with three different microstructures: (1) diffuse clots (grumose structure), (2) well-defined clots, or (3) homogeneous microspar. Fenestrae contain the remains of a low-diversity cryptic microbial community.



## GETTING OUR FEET WET: ANCIENT ALABAMA REEFS

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### ABSTRACT

Most of Alabama is underlain by strata that formed in marine or coastal environments. Many of Alabama's ancient rocks contain fossil reefs and mounds. Two examples of these ancient buildups are described. These are Mississippian reefs and mounds exposed at the surface in central and north Alabama and Jurassic mounds in the subsurface of southwest Alabama.

The Upper Mississippian Bangor Limestone was deposited on a broad platform that stretched across north Alabama. Small carbonate buildups grew in the central part of the platform. A mound in Lawrence County is dominated by echinoderms and fenestrate bryozoans. In situ colonies of the rugose coral *Caninia flaccida* compose about 8 percent of the mound by volume. The exposed portion of the mound is approximately 25 meters wide, 1.6 meters thick at the thickest point and roughly circular in plan. The mound possessed about 45 cm of synoptic relief. Strong currents within the mound are indicated by preferred orientation of corals and by coarse debris in channels between coral colonies. Corals are most abundant on the windward side of the mound, and scarsest to leeward. Other Bangor buildups in Alabama are coral biostromes, microbe-coral reefs, and bryozoan-microbial mounds.

Carbonate mounds flourished in the Upper Jurassic Smackover Formation on a 65-kilometer-long ridge. The ridge supported distinct communities of mound builders that constructed different kinds of mounds. On the southeastern ridge flank, a mound at least 18 meters thick is dominated by locally derived debris. The mound incorporated microherms (small bioherms) up to 1 meter thick, which account for 16 percent of the mound. The microherms were constructed by a previously unknown microorganism. On the northern part of the ridge crest a similar microhermal mound 8.5 meters thick is directly overlain by a microbial mound 9 meters thick. The microbial mound consists of stromatolite (laminated microbialite) and thrombolite (clotted microbialite) with diverse microstructures.

The reefs and mounds described in this paper represent only a small part of the known diversity of ancient buildups in Alabama.

### INTRODUCTION

This paper summarizes research on two ancient reef/mound trends in Alabama (Mississippian of north and central Alabama and Jurassic of southwest Alabama), which are

presented as examples of the diversity, abundance, and complexity of ancient organo-sedimentary buildups in the state.

## METHODS AND TERMINOLOGY

Analytical methods were described in Kopaska-Merkel and Haywick (2001) and in Kopaska-Merkel (2000). Bed thicknesses are classified following McKee and Weir (1953); particle and crystal sizes are classified using the standard Udden-Wentworth scale (e.g., Friedman and others 1992). Carbonate rock names follow the system of Dunham (1962), modified for kinds of boundstone following current usage. Particle types are listed in rock names in order of increasing abundance. Both metric and English units are used in this paper, because the U.S. petroleum industry uses English units. Carbonate buildups (bioherms) are reefs or mounds. Both exhibit synoptic relief, are constructed (at least in part) by autochthonous organisms, contain distinct biotic communities, and may exhibit ecological zonation. Larger buildups influence water and sediment movement. Reefs are held up (at least in part) by a rigid skeletal framework whereas mounds are not. Biostromes (life layers) are bioconstructions like mounds, but with a tabular form. Biodetrital mounds have a biotic component but no discernible framework of any kind. Microbial mounds have a microbial framework. Microherms (microbioherms) are small bioherms on the order of tens of centimeters across. Microherms in the Smackover consist of concentrically laminated (stromatolitic), clotted (thrombolitic), calcimicrobial, or structureless (lenticular) carbonate, and texturally resemble associated oncoids (algal balls). Microherms contain fossil assemblages different from those of enclosing strata. Thrombolites described here are composed of mesoscopic clots ranging from about 1 mm to about 1 cm across; these mesoclots exhibit a variety of shapes and microstructures. Calcimicrobes generated well-calcified deposits that preserved microbe morphology, commonly in conjunction with abundant syndimentary calcium-carbonate cement (Webb, 1996).

## MISSISSIPPIAN OF NORTH ALABAMA

Limestone and shale of the Upper Mississippian (Chesterian) Bangor Limestone crop out over a large area in north Alabama (Fig. 1). Most of the formation is composed of skeletal wackestone-packstone and oolitic grainstone. Uncommon carbonate buildups are small isolated reefs, mounds, and biostromes (Kopaska-Merkel and Haywick, 2001). The best exposed bioherm is a biodetrital mound located in a road cut on Highway 157 in Lawrence County, Alabama (Site H157, latitude 30° 24' 38" N, longitude 87° 49' 51" W; Fig. 1). The exposed part of the mound is approximately 25 m wide and up to 1.6 m thick and is composed of rugose corals in skeletal debris. Strata comprising this outcrop (Fig. 2) are assigned to the middle part of the Bangor because the exposure is centrally located within the Bangor outcrop belt (Szabo and others, 1988; Fig. 1). The excellent exposure of the Lawrence County mound permitted a detailed examination of a unique bioherm as well as the strata that enclose it. Previously reported Bangor bioherms are few, and no other biodetrital mounds have been noted in the unit. Objectives of this study were to document the characteristics of the mound and to establish the mechanism of mound development.

### *Stratigraphic and sedimentologic framework*

Chesterian sedimentation in northwest Alabama was strongly influenced by development of the Black Warrior foreland basin (Thomas, 1974, 1985; Mars and Thomas,

1999). Bangor deposition in north Alabama recorded deposition on a distally steepened ramp (Miesfeldt, 1985; Mars and Thomas, 1999). At the line of flexure of the ramp, in a belt trending NW-SE across western north Alabama, a major aggradational oolitic shoal complex developed in the Bangor (Thomas, 1972). Deposition seaward (southwest) of the shoal complex took place on the ramp-like margin of the Black Warrior foreland basin (Thomas, 1972), whereas deposition landward (northeast) of the shoal complex took place on the stable and gently inclined proximal ramp (Thomas, 1972; Fig. 1). Proximal Bangor carbonates on the Warrior platform contain minor siliciclastic material that becomes more abundant to the northeast, recording input of allogenic detritus from the craton (Thomas, 1972; Fig. 3). Bangor carbonate deposits grade northeastward into marginal marine and terrestrial deposits assigned to the Pennington Formation (Thomas, 1972). The Bangor ranges in thickness between 100 and 130 m throughout much of the Warrior platform (Pashin, 1993).

The Bangor in the study area abruptly overlies the terrestrial, marginal marine and nearshore marine siliciclastic strata of the Hartselle Sandstone, which forms a series of barrier island complexes and associated strata on the Warrior platform (Thomas, 1972; Fig. 3). Sea-level rise following deposition of the Hartselle flooded the shelf and permitted accumulation of transgressive carbonate and shale of the basal Bangor Limestone (Thomas, 1972; Andronaco, 1986; Pashin, 1993). For the most part, Bangor deposition on the Warrior platform appears to have been progradational or aggradational (Pashin, 1993; Mars and Thomas, 1999).

In the study area, the Bangor is unconformably overlain by marginal marine and terrestrial deposits of the upper Carboniferous Pottsville Formation (Thomas, 1972; Pashin, 1993; Fig. 3). Paleotopography on the Bangor surface influenced facies distribution in overlying strata (Pashin, 1993). Similarly the upper surface of the Hartselle Sandstone, uneven because of development of parallel barrier-island trends in the Hartselle (Thomas, 1972), probably influenced Bangor sedimentation pathways and facies distribution as well (Kopaska-Merkel and Haywick, 2001).

#### *Lithofacies descriptions*

Strata exposed at the study site were assigned to seven lithofacies based upon sedimentologic, paleontologic and petrographic characteristics: (A) Oolite, (B) Skeletal, (C) in situ Coral, (D) Coral Floatstone, (E) Cross-stratified Skeletal Grainstone, (F) Fenestral, and (G) Breccia. Vertical relationships among lithofacies are illustrated in Figure 4. The lithofacies were described by Kopaska-Merkel and Haywick (2001); those descriptions are summarized here.

#### *(A) Oolite lithofacies*

Oolitic grainstone and packstone are restricted to the lowest portion of the outcrop (Fig. 4). This lithofacies comprises approximately 20 percent of the exposure.

Most of the oolite is well sorted grainstone, but some intervals contain up to 20 percent microcrystalline carbonate. Intact fossils are uncommon, but skeletal debris is locally abundant. Beds are generally internally structureless. The exposed upper bounding surface of the Oolite Lithofacies is sharp and planar. Lateral continuity of the facies is unknown.

In thin section, ooids exhibit well preserved cortices with both concentric and radial structure (Fig. 5). Ooid nuclei are dominated by bryozoan fragments, echinoderm ossicles, peloids, intraclasts, and gastropods, in order of decreasing abundance. Ooids account for 78 percent of allochems in mud-free samples of the lithofacies and 66 percent of allochems in the lithofacies overall. Relative abundances of non-coated allochems are similar to those of ooid

nuclei. Bryozoan fragments, echinoderm ossicles, and intraclasts, in order of decreasing abundance, account for most noncoated particles. Some ooid cortices are moderately to heavily centripetally bored. Noncoated allochems and ooid nuclei display similar degrees and ranges of syndepositional particle alteration such as centripetal boring, micritization, and recrystallization. Particles range in degree of alteration from nearly pristine to highly degraded.

Most oolitic grainstone in this lithofacies was little compacted prior to cementation. Interparticle cements can exceed 30 percent by volume of oolitic grainstone and include very early isopachous marine spar, hematitic coats of uncertain origin, vadose meniscus microcrystalline spar, and pore-filling meteoric spar (Haywick and Kopaska-Merkel, in prep).

The muddy matrix filling interstitial space in packstone commonly appears clotted or micropeloidal (20-50  $\mu\text{m}$  in diameter; Fig. 5; cf., *structure grumelleuse*; Cayeux, 1935). Hence, some, and perhaps most, of the oolitic packstone at this location was deposited as a grainstone, and its muddy matrix may consist of peloids that were homogenized to lime mud by physical compaction or by diagenetic modification (Kopaska-Merkel and Haywick, 2001).

#### (B) Skeletal lithofacies

This is the dominant lithofacies, comprising approximately 40 percent of the total outcrop. Individual beds measure from 13 to 45 cm in thickness (medium- to thick-bedded), and vary in texture from grainstone to sparse packstone. Particles are generally fine to coarse sand size, but locally reach a few millimeters in diameter. Sorting ranges from fair to good. All beds are internally structureless. Bounding surfaces range from sharp (grainstone) to gradational (packstone). Separate beds are laterally continuous across the exposure, but their thicknesses vary owing to the uneven surfaces of some underlying coral-rich intervals.

Fossils are diverse and abundant and include scattered large bivalves, gastropods and rugose corals, but crinoids and bryozoans predominate. The Skeletal Lithofacies contains articulated bivalves in life position as well as patches of wackestone, indicating considerable heterogeneity of fabric. Point counting indicates varied proportions of primary constituents (echinoderms, bryozoans and ooids; Kopaska-Merkel and Haywick, 2001); however, ooids are commonly less abundant than either echinoderms or bryozoans. Most ooids are better described as superficially coated grains in contrast to those in the Oolite Lithofacies. Many of the bryozoans consist of large fragments or entire specimens of fenestrate forms and some echinoderm specimens are stalk fragments consisting of multiple ossicles. This lithofacies also contains fine skeletal material, much of it identified as bryozoan (Kopaska-Merkel and Haywick, 2001).

The abundance of microcrystalline carbonate matrix in this lithofacies decreases from north to south within single beds. In a series of six thin sections across the outcrop, the microcrystalline matrix decreased from approximately 45 to 30 percent; the implications are discussed in a later section. As in the Oolite Lithofacies, much of the muddy matrix within packstone components of this lithofacies is clotted. Percentages of cement are highly variable (1 to 25 percent, average 8 percent).

#### (C) In situ coral lithofacies

This lithofacies comprises colonies of *Caninia flaccida* (G. Webb, pers. commun., 1998) in growth or near growth position (subvertical to inclined orientation). It should be noted that the genus *Caninia* is in need of revision, and *C. flaccida* is a candidate for removal from the genus (G. Webb, pers. commun., 1998). Therefore, the generic assignment of corals at this outcrop is questionable. Two distinct horizons containing coral colonies have been

identified in the outcrop at 1.25 to 1.5 m and 1.75 to 2.5 m above the bottom of the exposure (Fig. 4). Individual colonies are up to 0.6 m in thickness (averaging 0.2 m) and up to 2 m in lateral extent (Fig. 6). Most colonies are roughly equant and domal, with most individual corals either radiating upward from a central point (30 percent of the corals examined), or inclined in one direction (between 270 and 310 degrees; 55 percent of the total). In situ colonies contain both adult and juvenile corals in a numerical ratio of approximately 2:1. Some coral colonies are multilayered, and contain one or more individuals that bud additional corals, but most smaller colonies are essentially one coral thick. Colonies that are not equant tend to be sheet-like. Rugosan colonies account for between 2 and 13 percent of the volume of the lower portion of the outcrop and are especially abundant immediately above the Oolite Lithofacies at the base of the exposure. Here corals may have grown directly on top of the oolitic grainstone. The percentage of coral colonies and average colony size increase steadily southward from the north end to the middle of the outcrop. Coral colonies are essentially monospecific, but bryozoans encrust some corals.

Interstitial material consists of fine skeletal packstone identical to the Skeletal Lithofacies from which it was derived. Detritus within coral intraskeletal pores is significantly finer, consisting mostly of mudstone with minor silt-size skeletal components (including ostracodes). The dimensions of intraskeletal pores presumably limited the size of sediment that could infiltrate coral skeletons.

#### (D) *Coral floatstone lithofacies*

This lithofacies is exposed only locally at the northern end of the outcrop; it comprises less than 5 percent of the exposure. Coral floatstone is primarily composed of adult rugose corals in an argillaceous matrix (Fig. 7). The lithofacies is lenticular (5 to 10 cm thick) and laterally interdigitates with the *in situ* Coral and Skeletal Lithofacies. The lower bounding surface is sharp to gradational and locally scoured. The upper contact is generally gradational, passing upward into skeletal grainstone or *in situ* coral colonies. Top and bottom surfaces of the Coral Floatstone Lithofacies are subparallel and the unit drapes over *in situ* coral colonies. Most corals in this lithofacies (71 percent) are broken and either horizontal or overturned, without preferred orientation. These characteristics distinguish this "rubble zone" from the *in situ* Coral Lithofacies.

It is not possible to resolve matrix-coral relationships in this facies, because the matrix is too friable. The corals are petrographically and taxonomically identical to those in the *in situ* Coral Lithofacies.

#### (E) *Cross-stratified skeletal lithofacies*

The Cross-Stratified Skeletal Lithofacies comprises a single bed 15 cm thick exposed at the south end of the roadcut. The unit makes up less than 5 percent of the outcrop. This lithofacies resembles the Skeletal Lithofacies, but is composed of cross-laminated grainstone. Planar-tabular cross laminac pass laterally into, and are overlain by, low-angle cross laminae. Some parts of the Cross-Stratified Skeletal Lithofacies exhibit normal grading and scour. Top and bottom contacts are sharp. Scours contain pockets of echinoderm-dominated sand that varies from very coarse sand to very fine gravel. This lithofacies pinches out northward to a feather edge just south of the center of the outcrop between strata assigned to the Fenestral Lithofacies.

The lithofacies is dominated by echinoderms, with lesser amounts of fenestrate and ramose bryozoans. Other allochems include endothyroid foraminifera, brachiopods, peloids, algae, and ostracodes. Despite well-developed cross-stratification, in thin section this

lithofacies appears to be an echinodermal packstone. As in the Oolitic and Skeletal Lithofacies, much of the "matrix" is clotted and in some places is clearly peloidal. Based on the cross lamination and peloidal "matrix," the lithofacies probably was deposited as a grainstone (Kopaska-Merkel and Haywick, 2001).

*(F) Fenestral lithofacies*

This lithofacies forms a single unit 46 cm thick near the top of the exposure and consists of yellow, fenestra-bearing, dolomitized pack-wackestone grading up to dolomudstone. The lithofacies is not internally stratified, but horizontal fenestrae are common. Calcite-filled vertical fenestrae which fork or bifurcate downward are especially common in the upper part of the lithofacies. The base of this lithofacies is sharp and planar but the upper contact is jagged. Macrofossils are limited to the lower part. Gastropods are the dominant fossils, but there are also bivalves (some in life position), and brachiopods with geopetal infilling.

*(G) Breccia lithofacies*

This lithofacies consists of a single unit with a maximum thickness of 22 cm, near the top of the exposure (Fig. 4). It contains abundant subangular to subrounded, yellow dolomudstone clasts up to 1 cm in diameter (Fig. 8). Pebble-size breccia in the lower 7 cm of the lithofacies grades up over 15 cm into a dark gray skeletal packstone containing pyrite, glauconite pellets, and phosphatic debris. The upper contact is the modern karstic surface. The Breccia Lithofacies is well exposed and laterally continuous over 20 m in the central portion of the outcrop, but it is poorly exposed elsewhere.

Breccia clasts consist of microcrystalline dolostone petrographically identical to the upper entirely dolomitized portion of the Fenestral Lithofacies. The surrounding matrix (in the coarse basal portion of the lithofacies) is a partially dolomitized carbonate that is too highly altered to permit unequivocal determination of depositional texture. By contrast, in the upper portion of the lithofacies where dolomite overprint was minor, the limestone is a fine- to very fine-grained packstone containing bivalves, echinoderm ossicles, bryozoans, trilobites, and ostracodes.

## DISCUSSION

The seven lithofacies described above were deposited in distinct shallow marine and peritidal sedimentary environments. The Oolite Lithofacies is interpreted as a shallow marine shoal deposit. The Skeletal Lithofacies was laid down on an open shallow marine shelf. However, skeletal strata that enclose *in situ* Coral and Coral Floatstone Lithofacies constitute biotrital carbonate bioherms (mounds; Fig. 9). The larger (higher) buildup measures 0.9 m thick at the core and thins toward the flanks. There is at least 45 cm of positive depositional relief at the top of this mound (Kopaska-Merkel and others, 1998) and this topography influenced the disposition of adjacent and overlying strata (Skeletal Lithofacies). Restriction of floatstone to the northern flank of the mound suggests it is a wash-over rubble bed, perhaps storm-generated, and that the northern flank is the leeward side of the mound. This inference is further supported by (1) greater abundance and larger sizes of coral colonies on the south end of the outcrop, (2) onlap of cross-stratified skeletal grainstone on the south side of the mound, and (3) lesser concentrations of microcrystalline matrix in the Skeletal Lithofacies on the south side of the mound. Higher energy, more open marine conditions on the windward side of the mound would have winnowed out fine mud and encouraged vigorous coral growth.

The Cross-Stratified Skeletal Lithofacies is spatially associated with the Fenestral Lithofacies and was deposited in a shallow marine, current swept, environment. It is interpreted as a sand wave. Proximity to fenestral dolomudstone, diagnostic of peritidal deposition, suggests a tidal influence, but storms and/or ocean currents are also possible causes of the cross-stratification.

The contact between the Fenestral and Breccia Lithofacies is interpreted as a subaerial exposure surface based upon the rootlets in the underlying Fenestral Lithofacies and the irregular form of the surface. Dolomite content within the Fenestral Lithofacies is greatest just below the contact with the overlying breccia and diminishes rapidly below this horizon, suggesting that the dolomite was produced during subaerial exposure (cf. Folk and Land, 1975). The breccia that directly overlies the exposure surface is composed of dolostone clasts containing dolomite petrographically identical to that in the Fenestral Lithofacies. The breccia is interpreted as a transgressive lag that formed following a relative rise in sea level. The uppermost part of the Breccia Lithofacies (fine skeletal packstone) records a transition back into shallow marine deposition.

The oolitic strata at the base of the outcrop are interpreted as the uppermost part of an ooid shoal. The Skeletal and *in situ* Coral Lithofacies probably formed in deeper water than any of the other lithofacies (Kopaska-Merkel and Haywick, 2001). Hence, the transition from oolitic grainstone to skeletal grainstone plus coral colonics records minor deepening (probably less than 5 meters). Strata between the Oolite Lithofacies and the exposure surface at the top of the Fenestral Lithofacies record filling of accommodation space following the transgression. A relative sea-level fall exposed the upper portion of the succession to meteoric diagenesis and soil development (Haywick and Kopaska-Merkel, in prep.). The availability of a hard substrate (e.g., cemented ooid grainstone) probably was a key factor in the origin of the mound.

Rugose corals colonized the hard substrate at the top of the ooid shoal. The windward flank of the developing mound lay to the southwest, toward the shelf margin (Fig. 1). The oolite shoal underlying the mound at our study site is not part of the Bangor oolitic bank margin complex, which lay 70 km to the southwest. It is inferred to have developed on a local paleohigh created by an accumulation of sand in the underlying Hartselle Sandstone. Thomas (1972) mapped numerous sand thicks in the Hartselle that have been interpreted as barrier island or strandplain deposits. The southwest (seaward) flank of one of the Hartselle sand lobes underlies the study site.

The paleohigh formed by the top of the ooid shoal was colonized by rugose corals, stalked echinoderms, and fenestrate bryozoans. Deposits of this interval form the lowest of two mound horizons at the study site, assigned to the Skeletal and *in situ* Coral Lithofacies. Together, these organisms produced an effective baffle with a thickness of up to 15 cm (the height of the largest corals). The coral-crinoid-bryozoan thicket provided a congenial shelter for a wide variety of other organisms such as benthic foraminifera, ostracodes, trilobites, gastropods, small bryozoans, brachiopods, and sponges. Locally derived skeletal debris, as well as intraclasts, ooids, and skeletal material from the surrounding shelf was trapped by the baffling organisms. As the mound grew, the trapped sediment preserved or even enhanced the pre-existing relief on the ooid shoal. As a result, skeletal sediment is thickest at the mound core. Mound growth was terminated when skeletal sand (Skeletal Lithofacies) inundated and covered the mound. This skeletal sediment thins over the crest of the mound, unlike the skeletal grainstone comprising the mound core, which forms beds that are relatively consistent in thickness (Kopaska-Merkel and Haywick, 2001).

A resumption of quiet-water conditions conducive to the growth of sessile benthos permitted corals, crinoids, and fenestrate bryozoans to recolonize the mound, forming the upper mound horizon. Because depositional relief of the mound had not been entirely obliterated, the mound resumed growth in the same location. The upper mound is similar to the lower. The major differences are a dearth of ooids and an increase in benthic foraminifera and bryozoans. The lack of ooids in the upper mound strata may record the disappearance from the vicinity of active ooid shoals. The upper mound was buried by skeletal debris, and conditions favorable for mound growth did not recur (Kopaska-Merkel and Haywick, 2001).

The Mississippian is well known for its abundance of bioherms, which have been well studied in Europe and western North America (e.g., Pray, 1961; Lees and Miller, 1995). However, no mounds had been reported from the Bangor Limestone in Alabama. The discovery of ten small carbonate buildups, one of which was large enough to affect paleocurrents during and after burial, demands revision of Chesterian paleoenvironmental interpretations in north Alabama. Small, inconspicuous mounds might have been relatively common on the Bangor shelf (Kopaska-Merkel and Haywick, 2001).

### JURASSIC OF SOUTH ALABAMA

The Smackover Formation is a subsurface carbonate ramp deposit that lies beneath the U.S. Gulf Coastal Plain from Texas to Florida. Although the Smackover is dominated by nonskeletal detrital carbonate, a variety of carbonate buildups have been described (e.g., Baria and others, 1982). In this section, examples of a previously unknown mound trend are described. More detailed descriptions of these strata can be found in Kopaska-Merkel (2000).

#### *Geologic setting*

The Smackover was deposited in southwest Alabama on a system of preexisting ridges and basins (Fig. 10). Lithologic characteristics of the Smackover differ among the basins and also with paleotopographic setting (for example, basin margin versus basin interior). The Smackover Formation (Oxfordian, Late Jurassic) conformably overlies the Norphlet Formation, a predominantly continental siliciclastic deposit formed in an arid climate (Wilkerson, 1981). The contact is commonly abrupt or gradational over an interval of a meter or less (Tolson and others, 1983; Kopaska-Merkel and others, 1992). Strata that formed under high-energy conditions (such as grainstone) were deposited in nearshore areas rimming exposed paleohighs and near the updip limit of Smackover deposition; muddy strata accumulated in basin centers.

Basal Smackover strata in Alabama contain bioherms and biostromes that formed in shallow water, especially in the southeastern Manila and northern Conecuh embayments (Kopaska-Merkel, 1994, 1998a). Middle Smackover strata, especially in basinal areas, are dominated by lime mudstone and pelletal or fossiliferous wackestone, deposited in relatively deep water. Prolific production of grainy nearshore carbonate sediment on the flanks of paleohighs initiated progradation of shallow-water strata. Upper Smackover strata comprise a succession of stacked, upward-shallowing cycles (Kopaska-Merkel and Mann, 1993, and references therein). Bioherms are widespread in upper Smackover strata in Alabama (Baria and others, 1982; Benson, 1988; Kopaska-Merkel and others, 1992; Don Fish, verbal commun., 1992; Benson and others, 1996). All known Smackover bioherms in Alabama are microbially dominated, though some contain the remains of foraminifera, sponges, skeletal algae, and metazoans (Baria and others, 1982; Crevello and Harris, 1984; Markland, 1992; Kopaska-Merkel, 1994, 1998a; Kopaska-Merkel and Schmid, 1999).



The Smackover Formation underlies the Buckner Anhydrite Member of the Haynesville Formation. The formation boundary corresponds to a brief hiatus and period of subaerial exposure of the top of the Smackover in much of southwest Alabama (Kopaska-Merkel and others, 1992; Mann and Kopaska-Merkel, 1992). This was followed by inundation with hypersaline waters. The basal Buckner is dominated by subaqueous evaporites in depositional basins and by peritidal strata on the flanks and crests of paleohighs (Mann, 1988; Mann and Kopaska-Merkel, 1992).

*Biotrital mound, southeastern ridge flank, mound petrography*

The core from well Permit No. 2943 (IJAMS core), located on the southeastern flank of the Saint Stephens Ridge (Fig. 10), penetrated 18.6 meters of microhermal wacke-pack-grainstone that has been interpreted as a biotrital mound (Kopaska-Merkel and Schmid, 1999). The core consists of dolomitic mixed-particle peloid wacke-pack-grainstone containing microherms. The microherms average 3.9 cm thick ( $n=84$ ), but range up to 0.32 meter thick; many exceed the width of the core (9 cm), and microherms that appear to be separate may be connected in three dimensions. Microherms account for 16 percent of the core by volume. Microherms consist of one or more of (1) the remains of tubular calcimicrobes (renaloid species A; Fig. 11) encased in radial fibrous calcium-carbonate cement, (2) thrombolite, and (3) ovoid or spheroidal sand-size peloids, in order of decreasing abundance. Matrix is dominated by peloids, but contains tubercoids, other intraclasts, oncoids, thin-shelled bivalves, benthic foraminifera, smooth-walled ostracodes, echinoid spines, and gastropods, in approximate order of decreasing abundance. Locally, the matrix contains burrows about 1 cm in diameter. Recognizable fragments of microherms account for only a small fraction of the matrix.

*Growth mechanisms*

Microherms grew by expansion of grounded oncoids and tubercoids. Some larger microherms exhibit shapes suggesting retrenchment and rejuvenation, and in some cases contain almost as much enveloped matrix material as they do microherm material (Kopaska-Merkel and Schmid, 1999). Strong waves or currents eroded the tops of microherms, generating tubercoids that became nuclei for oncoids. When water energy was lower, oncoids came to rest and new microherms commonly grew upon the microbial "seeds" (Kopaska-Merkel, 1994; Kopaska-Merkel and Schmid, 1999). The tops of microherms were bored at particular levels in the core (Kopaska-Merkel and Schmid, 1999). Borers may have been controlled by changes in water chemistry, such as fluctuations in oxygenation of bottom waters (Kopaska-Merkel, 1998b). Overall shoaling of the mound is suggested by upwardly increasing particle size, decreasing abundance of microherms, and increasing particle support in the matrix. Interaction between sediment supply, water chemistry, and water energy governed the interplay between formation of oncoids, conversion of mobile oncoids to sedentary microherms, and destruction of microherms with subsequent formation of new oncoids (Fig. 12).

The inferred mound-constructing action of the microherms involves biocementing, binding, and baffling. Biocementing and binding occurred within microherms through the formation of early marine cement coats on renaloid species A and the encrusting growth of thrombolite in layers a few 100  $\mu\text{m}$  to about 1 mm thick (Kopaska-Merkel and Schmid, 1999). Baffling occurred within and among microherms. Large microherms were efficient bafflers because they have complex, deeply invaginated shapes and envelop considerable amounts of rock matrix.

### *Comparison to other mounds*

The sediment body containing the microherms is known from a single core; it is not known whether the putative mound exhibited synoptic relief or affected water circulation. However, the fabric of the bioherm-bearing succession resembles that of the Bangor mound in Lawrence County. Mounds with a packstone fabric also have been reported from the Fort Payne Formation of Kentucky (Ausich and Meyer, 1990) and Viséan strata of Ireland and England (Lees and Miller, 1995). The IJAMS core contains 16 percent microherms, which compares favorably with the percentage of inferred framework material in the Bangor mound and in Waulsortian mud mounds (J. L. Wilson, 1975). Finally, microherms in the IJAMS core (chiefly constructed by renaloid species A) record the former presence of a distinctive mound biota.

Grainy microhermal mounds are a kind of bioherm previously unrecognized in Jurassic rocks. Although Jurassic mounds are widespread in outer ramp settings, they consist mainly of thrombolite, siliceous sponges, and carbonate mud (Leinfelder and others, 1994), and the only "rock-forming" microorganism in these mounds is *Tubiphytes morronensis* (e.g., Schmid, 1996).

### *Biotrital mound, northern ridge crest, mound substrate*

The 26.2 m core from well Permit No. 2769 (Wilson core) (Fig. 10) penetrated two stacked mounds in their entirety, as well as over- and underlying strata. The basal 6.1 m of core (the mound substrate) consists of very fine peloid grainstone. This unit contains oncoids, echinoderm ossicles (including spines), bivalve fragments, tuberooids containing renaloid species A, ostracode valves, intraclasts, *Parafavreina*, and quartz silt. A 1-m-thick interval contains up to 40 percent poorly preserved small microherms.

### *Mound petrography*

The mound substrate grades up over a meter or less into a microhermal biotrital mound. In the transition zone, 1 to 3 cm of oncoid packstone grade up into coarser microhermal packstone. The mound, which is 8.5 m thick, consists of small microherms embedded in a matrix of silt to very fine sand size oncoidal tuberooid peloid grainstone. Microherms account for 15 to 50 percent of the mound (averaging 25 to 30 percent). Fragments of microherms are uncommon in the matrix. Oncoids contain peloids but no skeletal microfossils. Microherms are crudely laminated and clotted; their nuclei resemble associated oncoids. Microherm cortices are dominated by fans or botryoids of coarse, inclusion-rich spar, but they also contain microspar, renaloid species A, well-defined peloids, and peloids with diffuse boundaries (grumose structure). Associated biota include bivalves, possible dasycladacean algae, and *Parafavreina*. Renaloid species A, which is found in microherms but not in oncoids in this core, may have preferred a physically stable microenvironment, growing only on particles that were at rest for significant periods. It is also possible that renaloid species A thrive only under conditions hostile to the growth of other calcifying organisms. This is inferred from the observation that renaloid species A is common where other fossils are scarce (Kopaska-Merkel and Schmid, 1999).

### *Comparison to other mounds*

This mound differs from that in the IJAMS core: microherms are more abundant, the mound deposits are thinner, and well preserved specimens of renaloid species A are scarce. Figure 13 schematically represents the morphology of microhermal biotrital mounds at the time of formation.

### *Capping facies*

The biodetrital mound is abruptly overlain by a layer of oncolitic tubercoid peloidal packstone 0.8 to 1.7 m thick (0.9 m of core are missing), which appears identical to the matrix of the biodetrital mound, but lacks recognizable microherms. This debris layer is overlain by a microbial mound (see below).

### *Microbial mound, northern ridge crest, mound petrography*

A microbial mound nucleated on the top of a thin layer of debris mantling a biodetrital mound. The microbial mound consists of thinly laminated microbialite (stromatolite) and crudely laminated to thin bedded microbialite composed of millimeter- to centimeter-scale irregular strata, blobs of various shapes, and uneven coatings, here all considered to be thrombolite. The microbial mound is a 9-m-thick thrombolite-stromatolite complex (Fig. 13) in which renaloid species A is rare, but other fossils are abundant and diverse. Thrombolite (Fig. 14 A-B) accounts for well over half the volume of this interval. At least three distinct thrombolite microstructures are represented: diffuse clots (grumose structure; Fig. 14 A; c.f., Turner and others, 2000), well-defined clots (Fig. 14 B, base), and homogeneous microspar (Fig. 14 B, top). Thrombolites with differing microstructures overlie one another directly (Fig. 14 B), in a constructional relationship that Wood (1999) called mutual encrustation. Microscopic elements (e.g., *Parafavreina*) exhibit consistent preservational styles throughout the thrombolite-stromatolite complex, which suggests that the three distinct thrombolite microstructures do not result from variable taphonomic or diagenetic effects (c.f., Turner and others 2000), but were formed by three different organisms or biotic associations. The thrombolite-stromatolite complex includes *Parafavreina* (Fig. 14 B); *Helicerina* (Fig. 15); intraclasts; ooids; oncoids; foraminifera; bivalve and gastropod mollusks; echinoderm ossicles; smooth-walled ostracodes; calcispheres; coccoid calcimicrobes embedded within the primary framework (Fig. 14 A, center); renaloid species A (an uncommon component of the primary framework); several distinct unidentified microfossils; mica and quartz silt within the framework, and microcrystalline clots, laminae, drapes, and irregular blobs that secondarily (Wood, 1999) encrusted the thrombolite or stromatolite framework (Fig. 16). Framework is used here to refer to the three-dimensional body (chiefly consisting of calcium carbonate), which was constructed by thrombolitic and stromatolitic microbes, and which does not necessarily contain calcified skeletons. The framework exhibits the following characteristics: (1) biologic encrustation, (2) in situ brecciation, and (3) near-vertical exterior surfaces. No evidence of bioerosion was recognized. The microbial framework probably was lithified at or just after the time of formation.

### *Fenestrae*

The thrombolite contains abundant fenestral or crypts (Fig. 16), which may have formed as gas evolved during decay of microbial mats. Fenestral in the lower two-thirds of the mound are filled with three generations of cement: silt-size clear pore-rimming bladed calcium carbonate, fine to medium textured planar-s dolomite, and medium textured clear blocky pore-filling calcium carbonate.

Fenestrae in the upper third of the mound contain a very different succession of phases (Fig. 17 B). Thrombolite surfaces lining fenestral in the upper part of the mound are locally encrusted by microcrystalline stalagmitic and stalactitic deposits (Fig. 16) that are probably microbial. Medium textured inclusion-rich calcium-carbonate crystals with abundant nonplanar boundaries and few enfacial junctions form a pore lining that has an irregular surface; this phase overlies the microcrystalline stalagmitic and stalactitic carbonate.

Inclusion-rich spar contains inclusion-rich planar-e dolomite, which has been extensively calcitized and locally pyritized. Inclusion-rich spar is locally underlain and locally overlain by a thin discontinuous rind of silt-size limpid planar-e dolomite. Inclusion-rich spar is overlain by pore-filling medium textured clear blocky calcium carbonate with abundant enfacial junctions.

It is suggested that inclusion-rich spar records the former presence of a prolific microbial binder of unknown affinities, which induced precipitation of magnesian calcite that was later either neomorphosed to inclusion-rich calcite (e.f., Monty, 1967; Buczynski and Chafetz, 1991; Arp, 1995; González-Muñoz and others, 2000) or replaced by dolomite. In either case, most of the dolomite was replaced by inclusion-rich spar. Following formation of inclusion-rich spar and local dolomite cement, medium textured blocky calcium-carbonate cement filled most of the remaining primary porosity in the upper part of the mound. A trace of primary porosity remains locally.

Recognizable remains of the organisms that actually constructed the mound are preserved only locally in this core (e.g., renaleid species A) and the nature and affinities of the major constructors are unknown.

#### *Comparison to other mounds*

The preserved biota of this mound is more diverse than those of most mounds previously reported from the Smaekover of Alabama (e.g., Baria and others, 1982; Kopaska-Merkel, 1998a). Clearly, environmental conditions on the Saint Stephens ridge during late Smaekover time were conducive to microbial growth.

#### *Capping facies*

The mound is abruptly overlain by tuberoid peloid packstone and this in turn is overlain by oolitic grainstone with keystone vugs. These two units are interpreted to record rapid development of a beach on top of the mound, perhaps by progradation from a nearby island or by a drop in sea level. Flaty tuberoids up to 2 cm across in the tuberoid peloid packstone resemble the upper part of the underlying mound and also resemble tuberoids trapped within large fenestrae in the uppermost 0.5 m of the mound.

## DISCUSSION

#### *Paleoenvironmental setting of mounds*

The biodetrital mound at the south end of the ridge consists of calcimicrobial microherms in a wacke-pack-grainstone matrix. This mound is dominated by a single taxon, the calcimicrobial renaleid sp. A, and faunal diversity is very low. The base and top of the mound were not cored. Water depth during mound growth probably was less than about 35 m, for the base of the core is 35.6 m below the top of the Smaekover, inferred to consist of peritidal deposits as it does in nearly every core in this area. Thickness of upper Smaekover strata is considered a good predictor of paleowater depth. Upper Smaekover strata were deposited during a single sea-level highstand and there is no evidence for major sea-level fluctuations during late Smaekover time in southwest Alabama (Maneini and Benson, 1980; C. H. Moore, 1984; Benson, 1988; Maneini and others, 1990; King and Moore, 1992; Kopaska-Merkel and others, 1992; Mann and Kopaska-Merkel, 1992; Benson and others, 1996). Subsidence on this passive margin during the brief time represented by the upper Smaekover (part of the late Oxfordian) probably was negligible compared to the sediment accumulation rate.

A similar microhermal biodetrital mound was cored in its entirety in the Wilson core. The mound is underlain by peloid grainstone interpreted as a lagoonal or subtidal shelf deposit. The biota in the mound substrate is more diverse than that of the mound itself. The base of the mound is 19.4 m below peritidal (beach) deposits at the top of the core and therefore the mound probably grew in water less than 20 meters deep (see previous paragraph). The mound is mantled by a debris layer generated by storm reworking of the upper part of the mound. The two biodetrital mounds appear to have grown in essentially the same way (Fig. 13). Mound growth was initiated within the euphotic zone when water energy decreased to a point at which oncoids ceased to roll frequently and became microherms. Fluctuation in water energy and oxygenation during mound growth affected rates of microherm growth and destruction by waves and boring organisms. These fluctuations could have been caused by small-scale sea-level changes. The mounds were killed when water energy increased once more and mobile sediment buried the mounds.

A microbial mound, 9 meters thick and cored in its entirety, overlies the biodetrital mound in the Wilson core. Although the framework of the mound is entirely microbial, the preserved community is unusually diverse for the Alabama Smackover. Framework elements include three distinctly different thrombolite microstructures as well as stromatolites. Incorporated biogenic material is taxonomically diverse and a variety of noncalcified microbes inhabited crypts. There is little evidence of bioerosion. In contrast to the biodetrital mound lower in the core, the microbial mound in the Wilson core contains no recognizable remains of the framework constructing organisms, whose nature and affinities are unknown. The diverse biota, including two genera of thalassinideans and probable photosynthesizers (noncalcified and calcified cyanobacteria), indicates that the site was home to a thriving community during late Smackover time (Fig. 17) and that waters were probably well ventilated and shallow. The base of the mound is 11 meters below inferred beach deposits at the top of the core, and therefore the mound probably grew in water no deeper than 11 meters (see previous discussion of sea-level history). The microbial mound began to grow when water energy decreased, stabilizing mobile sea floor sediment. Mound growth continued while moderate levels of water energy maintained circulation but did not smother or break up the mound. Mound growth ended when increased wave agitation, possibly associated with storm activity, caused scouring of the "crest," filled open cavities in the upper part of the complex with debris, and buried the mound (Fig. 18).

The Saint Stephens ridge was shallowly submerged and probably locally subaerially exposed during late Smackover time. Water overlying the ridge during late Smackover time probably departed significantly from normal marine conditions and may have been moderately hypersaline. Abnormal water characteristics in southwest Alabama during the late Oxfordian may have excluded members of the Jurassic coral-calcified sponge-solenoporaccan algal-microbialite community, which formed many shallow-marine Jurassic bioherms (Leinfelder, 1994, cited in Wood, 1999). Environmental exclusion of typical European Oxfordian shallow-marine communities from the Alabama Smackover could explain the importance of thrombolites, which have been interpreted as indicating deep-water deposition in the Oxfordian of Europe (Leinfelder, 1994). Biodetrital and microbial mounds in the Smackover Formation on the Saint Stephens ridge may be appropriate models for Mesozoic mounds in restricted, shallow-water settings.

## CONCLUSION

Most of Alabama is underlain by strata that formed in marine or coastal environments. These units range in age from more than half a billion years old to deposits forming today on the coast and in Mobile Bay. Many of Alabama's ancient rocks and sediments contain fossil reefs or mounds, ecologically similar to living oyster reefs in modern Mobile Bay. Reefs and mounds (collectively called bioherms) are organosedimentary buildups: positive features made by, or influenced by, organisms. Reefs are held up (at least in part) by rigid frameworks; mounds lack such frameworks.

Two examples of these ancient buildups are described. These include Mississippian bioherms and biostromes exposed at the surface in central and north Alabama and Jurassic bioherms buried more than a mile beneath the surface in southwest Alabama.

The Chesterian (Upper Mississippian) Bangor Limestone was deposited on a broad platform that stretched across north Alabama. Small carbonate buildups grew on local topographic highs in the central part of the Bangor marine shelf. A mound near Moulton in Lawrence County consists chiefly of packstone and grainstone dominated by echinoderm ossicles and fragments of fenestrate bryozoans. In situ colonies of the rugose coral *Caninia flaccida* compose about 8 percent of the mound by volume. The exposed portion of the mound is approximately 25 m wide, 1.6 m thick at the thickest point and roughly circular in plan. The mound possessed about 45 cm of synoptic relief when fully developed. Strong currents within the mound are indicated by preferred orientation of corals and by coarse, commonly cross-stratified grainstone in channels between neighboring coral colonies. Corals are most abundant on the windward side of the mound, where they account for about 13 percent of the mound, compared to 6 to 10 percent in the central part of the mound, and 2 to 4 percent on the leeward flank. Other (smaller) Bangor buildups in Alabama are rugose-coral biostromes, microbially bound rugose-coral reefs, or bryozoan-microbial mounds.

Carbonate mounds flourished in the Oxfordian (Upper Jurassic) Smaekover Formation on the 65-kilometer-long Saint Stephens ridge. The ridge originated as an accumulation of eolian sand in the Norphlet Formation, which in turn formed upon a positive erosional feature on the pre-Mesozoic basement. The ridge crest, up to 15 kilometers wide, supported distinct communities of mound builders and associated organisms that constructed fundamentally different kinds of mounds.

On the southeastern ridge flank, a biodetrital mound at least 18 meters thick is dominated by locally derived nonskeletal packstone. The mound incorporated microherms (small bioherms) up to 1 meter thick, which account for 16 percent of the mound. The microherms were constructed by a renaleid calcimicrobe (microorganism that induced the precipitation of a calcified "skeleton"). On the northern part of the ridge crest a similar microherm-bearing biodetrital mound 8.5 meters thick is directly overlain by a microbial mound 9 meters thick. The microbial mound consists of stromatolite (laminated microbialite) and of thrombolite (clotted microbialite) with three different microstructures: (1) diffuse clots (grumose structure), (2) well-defined clots, or (3) homogeneous microspar. Fenestrae within thrombolite contain the remains of a low-diversity eryptic microbial community.

Alabama has been home to many different kinds of mound-building organisms over the past half a gigayear. When environmental conditions were right, these organisms built mounds and reefs in the nearshore marine environments that so often occupied Alabama. Much of our state was deposited in these environments because they facilitate rapid sediment accumulation. Terrestrial environments are disproportionately underrepresented in the rock

record, even though they represent nearly all of what we experience in our daily lives, because they are predominantly erosional.

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## LITERATURE CITED

- Andronaco, Peter, 1986, Lithofacies, depositional environments, and cyclicity of the Bangor Limestone in Blount County, north-central Alabama: unpubl. M.S. thesis, University of Alabama, 250 p.
- Arp, Gernot, 1995, Lacustrine bioherms, spring mounds, and marginal carbonates of the Ries-impact-crater (Miocene, southern Germany): *Facies*, v. 33, p. 35-90.
- Ausich, W. I., and D. L. Meycr, 1990, Origin and composition of carbonate buildups and associated facies in the Fort Payne Formation (Lower Mississippian, south-central Kentucky): An integrated sedimentologic and paleoecologic analysis: *Geological Society of America Bulletin*, v. 102, p. 129-146.
- Baria, L. R., Stoudt, D. L., Harris, P. M., and Crevello, P. D., 1982, Upper Jurassic reefs of Smackover Formation, United States Gulf Coast: *American Association of Petroleum Geologists Bulletin*, v. 66, p. 1449-1482.
- Benson, D. J., 1988, Depositional history of the Smackover Formation in southwest Alabama: *Gulf Coast Association of Geological Societies Transactions* 38, p. 197-205.
- Benson, D. J., Pultz, L. M., and Bruner, D. D., 1996, The influence of paleotopography, sea level fluctuation, and carbonate productivity on deposition of the Smackover and Buckner Formations, Appleton Field, Escambia County, Alabama: *Gulf Coast Association of Geological Societies Transactions*, v. 46, p. 15-23.
- Buczynski, Chris, and Chafetz, H. S., 1991, Habit of bacterially induced precipitates of calcium carbonate and the influence of medium viscosity on mineralogy: *Journal of Sedimentary Petrology*, v. 61, p. 226-233.
- Cayeux, L., 1935, *Les roches sédimentaires de France; roches carbonatées*: Paris, Masson, 463 p.
- Crevello, P. D., and Harris, P. M., 1984, Depositional models for Jurassic reefal buildups, in W. P. S. Ventress, D. G. Bebout, B. F. Perkins, and C. H. Moore, eds., *The Jurassic of the Gulf rim: Gulf Coast Section SEPM*, p. 57-102.
- Dunham, R. J., 1962, Classification of carbonate rocks according to depositional texture, in Ham, W. E. ed., *Classification of carbonate rocks*: American Association of Petroleum Geologists Memoir 1, p. 108-121.
- Folk, R. L., and Land, L. S., 1975, Mg/Ca ratio and salinity: two controls over crystallization of dolomite: *American Association of Petroleum Geologists Bulletin* 59, p. 60-68.
- Friedman, G. M., Sanders, J. E., and Kopaska-Merkel, D. C., 1992, *Principles of Sedimentary Deposits*: New York, Macmillan Publishing Co., 717 p.
- González-Muñoz, M. T., Chekroun, K. B., Aboud, A. B., Arias, J. M., and Rodríguez-Gallego, Manuel, 2000, Bacterially induced Mg-calcite formation: Role of  $Mg^{2+}$  in development of crystal morphology: *Journal of Sedimentary Research*, v. 70, p. 559-564.

- King, D. T., and Moore, D. K., 1992, Jurassic Smaekover Formation sequence stratigraphy, southern Manila embayment, Alabama: Gulf Coast Association of Geological Societies Transactions, v. 42, p. 503-510.
- Kopaska-Merkel, D. C., 1994, Oncoids to reefs: Rolling stones come to rest in the Smackover Formation: Gulf Coast Association of Geological Societies Transactions, v. 44, p. 347-353.
- Kopaska-Merkel, D. C., 1998a, Jurassic Reefs of the Smaekover Formation in south Alabama: Alabama Geological Survey Circular 195, 28 p.
- Kopaska-Merkel, D. C., 1998b, Basin analysis of the Mississippi interior salt basin and petroleum system modeling of the Jurassic Smaekover Formation, eastern gulf coastal plain, Final report, Year 2: Task 2--Formation Tops; Task 3B--Petrographic Study: Alabama Geological Survey Open-File Report, 107 p.
- Kopaska-Merkel, D. C., 2000, Basin analysis of the Mississippi interior salt basin and petroleum system modeling of the Jurassic Smackover Formation, eastern Gulf coastal plain, final report, year 4, Petrographic Study of Smaekover Cores: Alabama Geological Survey Open-File Report, 143 p.
- Kopaska-Merkel, D. C., and Haywick, D. W., 2001, A lone biotrital mound in the Chesterian (Carboniferous) of Alabama? Sedimentary Geology, v. 145, p. 253-268.
- Kopaska-Merkel, D. C., Haywick, D. W., and Robinson, J., 1998, A baffling Chesterian mud mound in north Alabama: Geological Society of America Abstracts with Programs, v. 30, n. 7, p. 315-316.
- Kopaska-Merkel, D.C., and Mann, S.D., 1993, Upward shoaling cycles in Smackover carbonates of southwest Alabama: Gulf Coast Association of Geological Societies Transactions, v. 43, p. 173-181.
- Kopaska-Merkel, D. C., Mann, S. D., and Schmoker, J. W., 1994, Controls on reservoir development in a shelf carbonate: Upper Jurassic Smackover Formation of Alabama: American Association of Petroleum Geologists Bulletin 78, p. 938-959.
- Kopaska-Merkel, D. C., Moore, H. E., Jr., Mann, S. D., and Hall, D. R., 1992, Establishment of an oil and gas database for increased recovery and characterization of oil and gas carbonate reservoir heterogeneity, Appendix I: Draft topical report on subtasks 2 and 3 (4 volumes), DOE Contract No. DE-FG22-89BC14425, 746 p.
- Kopaska-Merkel, D. C., and Schmid, D., 1999, New (?) bioherm-building tubular organism in Jurassic Smackover Formation, Alabama: Gulf Coast Association of Geological Societies Transactions, v. 49, p. 300-309.
- Lees, A., and Miller, J., 1995, Waulsortian banks, in C. L. V. Monty, D. W. J. Bosence, P. H. Bridges, and B. R. Pratt, eds., Carbonate Mud-Mounds: Their origin and evolution: International Association of Sedimentologists Special Publication No. 23, p. 191-271.
- Leinfelder, R. R., 1994, Distribution of Jurassic reef types: A mirror of structural and environmental changes during the breakup of Pangea, in Pangea: Global environments and resources: Canadian Society of Petroleum Geologists, Memoir 17, p. 677-700.
- Leinfelder, R. R., Krautter, M., Latenser, R., Nose, M., Schmid, D. U., Schweigert, G. , Werner, W., Keupp, H., Brugger, H., Herrmann, R., Rehfeld-Kiefer, U., Schroeder, J. H., Reinhold, C., Koch, R., Zeiss, A., Schweizer, V., Christmann, H., Menges, G., and Luterbaeher, H. (ed. and coord. by R. R. Leinfelder), 1994, The origin of Jurassic reefs: Current research developments and results: Facies, v. 31, p. 1-56.
- Mancini, E. A., and Benson, D. J., 1980, Regional stratigraphy of Upper Jurassic Smackover carbonates of southwest Alabama: Gulf Coast Association of Geological Societies Transactions, v. 30, p. 151-165.



- Mancini, E. A., Tew, B. H., and Mink, R. M., 1990, Jurassic sequence stratigraphy in the Mississippi interior salt basin of Alabama: Gulf Coast Association of Geological Societies Transactions, v. 40, p. 521-530.
- Mann, S. D., 1988, Subaqueous evaporites of the Buckner member, Haynesville Formation, northeastern Mobile County, Alabama: Gulf Coast Association of Geological Societies Transactions, v. 38, p. 187-196.
- Mann, S. D., and Kopaska-Merkel, D. C., 1992, Depositional history of the Smackover-Buckner transition, eastern Mississippi interior salt basin: Gulf Coast Association of Geological Societies Transactions, v. 42, p. 245-265.
- Markland, L. A., 1992, Depositional history of the Smackover Formation, Appleton field, Escambia County, Alabama: Tuscaloosa, Alabama, University of Alabama, unpublished M.S. thesis, 145 p.
- Mars, J. C., and Thomas, W. A., 1999, Sequential filling of a late Paleozoic foreland basin: Journal of Sedimentary Research, v. 69, p. 1191-1208.
- McKee, E. D., and Weir, G. W., 1953, Terminology for stratification and cross-stratification in sedimentary rocks: Geological Society of America Bulletin, v. 64, p. 381-389.
- Miesfeldt, M. A., 1985, Facies relationships between the Parkwood and Bangor Formations in the Black Warrior basin [unpublished M.S. thesis]: The University of Alabama, Tuscaloosa, Alabama, 149 p.
- Monty, C., 1967, Distribution and structure of Recent stromatolitic algal mats, eastern Andros Island, Bahamas: Annales Société Géologique Belgique, Bulletin 90, p. 55-100.
- Moore, B. R., 1986, Upper Jurassic carbonate/evaporite shelf, southern Alabama and western Florida [abs.]: American Association of Petroleum Geologists Bulletin, v. 70, p. 622.
- Moore, C. H., 1984, The upper Smackover of the Gulf rim: depositional systems, diagenesis, porosity evolution and hydrocarbon production, in Ventress, W. P. S., Bebout, D. G., Perkins, B. F., and Moore, C. H., eds., The Jurassic of the Gulf Rim: Proceedings of the Third Annual Research Conference, Gulf Coast Section, Society of Economic Paleontologists and Mineralogists, p. 283-307.
- Pashin, J. C., ed., 1993, New perspectives on the Mississippian system of Alabama: Alabama Geological Society Field Trip Guidebook 30, 151 p.
- Pray, L. C., 1961, Geology of the Sacramento Mountains escarpment, Otero County, New Mexico: New Mexico Bureau of Mines and Mineral Resources Bulletin 35, 144 p.
- Schmid, D. U., 1996, Marine Mikrobolithe und Mikroinkrustierer aus dem Oberjura. (Marine microbolites and micro-encrusters from the Upper Jurassic.): Profil, v. 9, p. 101-251. [In German with English abstract and figure captions.]
- Szabo, M. W., Osborne, W. E., and Copeland, C. W., Jr., 1988, Geologic map of Alabama (northwest sheet): Alabama Geological Survey Special Map 220, 4 pls.
- Thomas, W. A., 1972, Mississippian stratigraphy of Alabama: Alabama Geological Survey Monograph 12, 121 p.
- Thomas, W. A., 1974, Converging clastic wedges in the Mississippian of Alabama: Geological Society of America Special Paper 148, p. 187-207.
- Thomas, W. A., 1985, The Appalachian-Ouachita connection: Paleozoic orogenic belt at the southern margin of North America: Annual Review of Earth and Planetary Sciences, v. 13, p. 175-199.
- Tolson, J. S., Copeland, C. W., and Bearden, B. L., 1983, Stratigraphic profiles of Jurassic strata in the western part of the Alabama coastal plain: Alabama Geological Survey Bulletin 122, 425 p.

- Turner, E. C., James, N. P., and Narbonne, G. M., 2000, Taphonomic control on microstructure in Early Neoproterozoic reefal stromatolites and thrombolites: *Palaos*, v. 15, p. 87-111.
- Webb, G. E., 1996, Was Phanerozoic reef history controlled by the distribution of non-enzymatically secreted reef carbonates (microbial carbonate and biologically induced cement)?: *Sedimentology*, v. 43, p. 947-971.
- Wilkerson, R. P., 1981, Environments of deposition of the Norphlet Formation (Jurassic) in south Alabama: Tuscaloosa, Alabama, University of Alabama, unpublished M.S. thesis, 141 p.
- Wilson, G. V., 1975, Early differential subsidence and configuration of the northern gulf coast basin in southwest Alabama and northwest Florida: *Gulf Coast Association of Geological Societies Transactions*, v. 25, p. 196-206.
- Wilson, J. L., 1975, *Carbonate facies in geologic history*: New York, Springer-Verlag, 471 p.
- Wood, Rachel, 1999, *Reef evolution*: Oxford, Oxford University Press, 414 p.

## GLOSSARY

- Allochem.** A particle in a carbonate rock; i.e., not mud or cement.
- Biodetrital.** Pertaining to carbonate mounds. Indicates a mound that is essentially a pile of debris, albeit formed (at least in part) by the action of organisms.
- Bioherm.** A positive-relief feature built (at least in part) by organisms. Bioherm biotas commonly differ from surrounding flat-bottom communities. Bioherms are large enough to affect water circulation and may show ecological zonation.
- Biostrome.** A planar feature built (at least in part) by organisms.
- Bryozoan.** "Moss animals." Relatives of brachiopods that resemble miniature colonial corals. Habits are upright, encrusting, or (less commonly) boring.
- Buildup.** See *bioherm*.
- Calcmicrobe.** A microscopic organism that induces precipitation of calcium carbonate in such a way as to preserve some aspects of its form when alive. Not shells or skeletons per se, calcimicrobial precipitates tend to vary in their fidelity of preservation.
- Dolomite.** Calcium-magnesium carbonate. A mineral most commonly formed by the replacement of calcium carbonate (calcite or aragonite).
- Fenestra.** Window-like opening.
- Floatstone.** A carbonate rock type in which large particles "float" in a finer matrix.
- Grainstone.** A carbonate rock type in which particles support one another and mud matrix is minor or absent. A lithified carbonate sand.
- Intraclast.** A particle (clast) that was deposited, lithified, broken loose, and reworked into the same deposit in which it was originally laid down. This is a common process in carbonate rocks.
- Micrite.** Lime mud; microcrystalline limestone.
- Microbialite.** A carbonate rock formed by the action of microbes.
- Microherm.** A small *bioherm* (which see).
- Mound.** A positive-relief feature made (at least in part) by organisms, but lacking a rigid skeletal framework. Mound biotas commonly differ from surrounding flat-bottom communities. Mounds are large enough to affect water circulation and may show ecological zonation.
- Oncoid.** "Algal ball." A spheroidal particle, millimeters to centimeters in diameter, made by the concentric encrustation of a nucleus by algae, cyanobacteria, or other microbes.

**Ooid.** A spheroidal particle, up to about 1 mm in diameter, evenly concentrically laminated, that has a smooth exterior.

**Oolite.** A rock composed chiefly of ooids.

**Packstone.** A carbonate rock consisting of particles that are in contact but contain some lime mud in its interstices.

**Peloid.** A spheroidal microcrystalline carbonate particle of indeterminate origin. Most peloids are either fecal pellets or particles that were converted to microcrystalline carbonate through the action of microborers.

**Reef.** Like a *mound* (which see) but with a rigid skeletal framework supporting at least part of the structure.

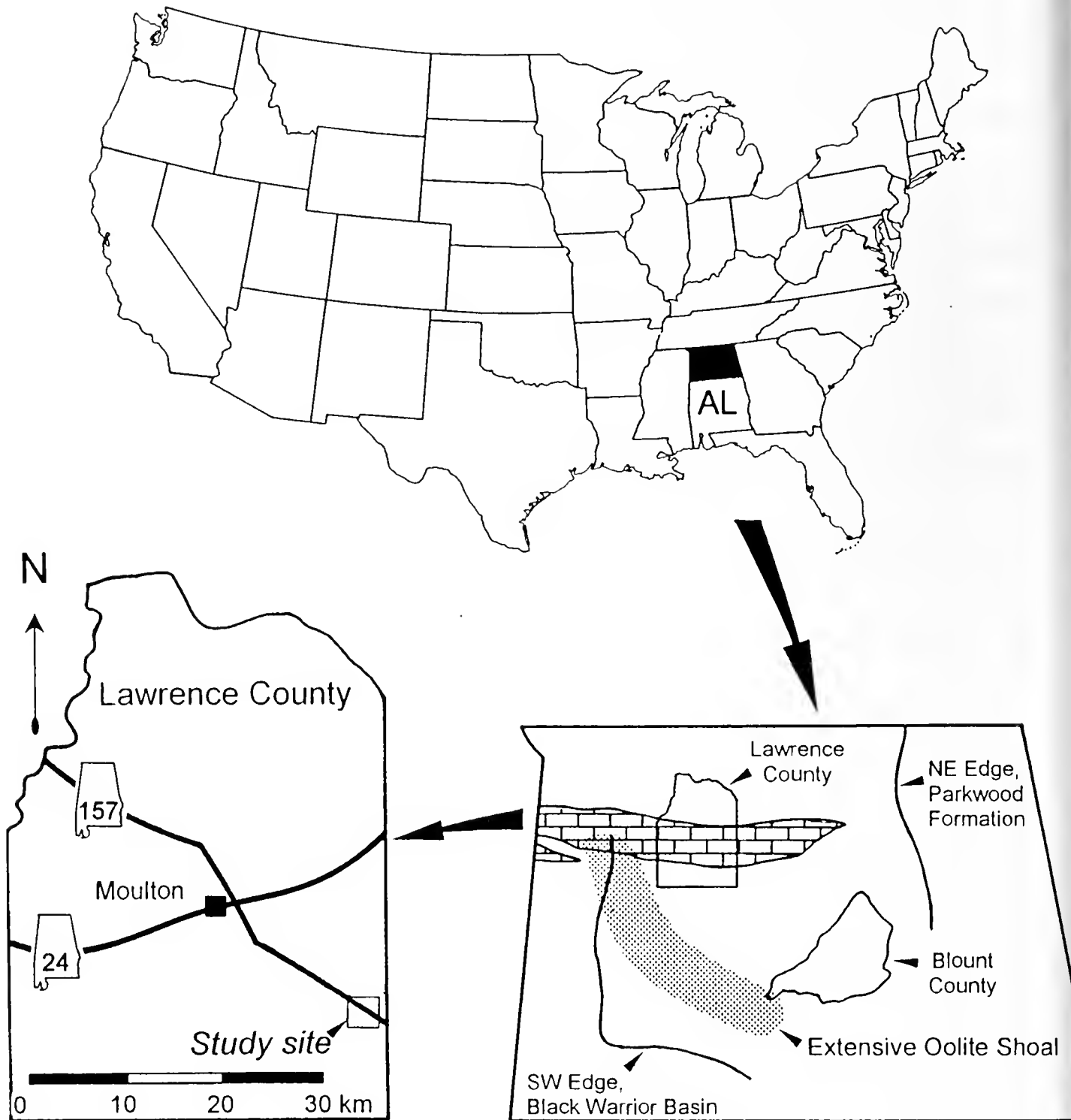
**Rugose Coral.** A group of Paleozoic corals, mostly solitary, only distantly related to modern corals. Solitary rugose corals are conical or banana shaped.

**Stromatolite.** A laminated rock that was formed as a result of the influence of algae, cyanobacteria, or other microbes.

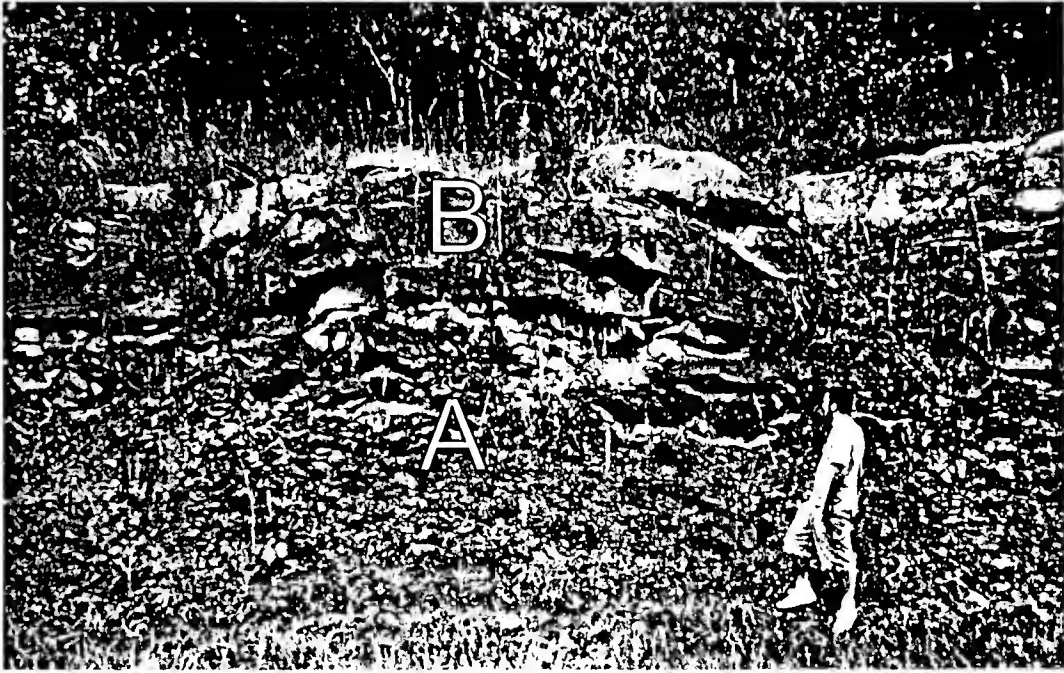
**Thrombolite.** A clotted rock that was formed as a result of the influence of algae, cyanobacteria, or other microbes.

**Vadose.** Formed in the zone of partial water saturation (e.g., the soil zone). Refers to calcium-carbonate cements.

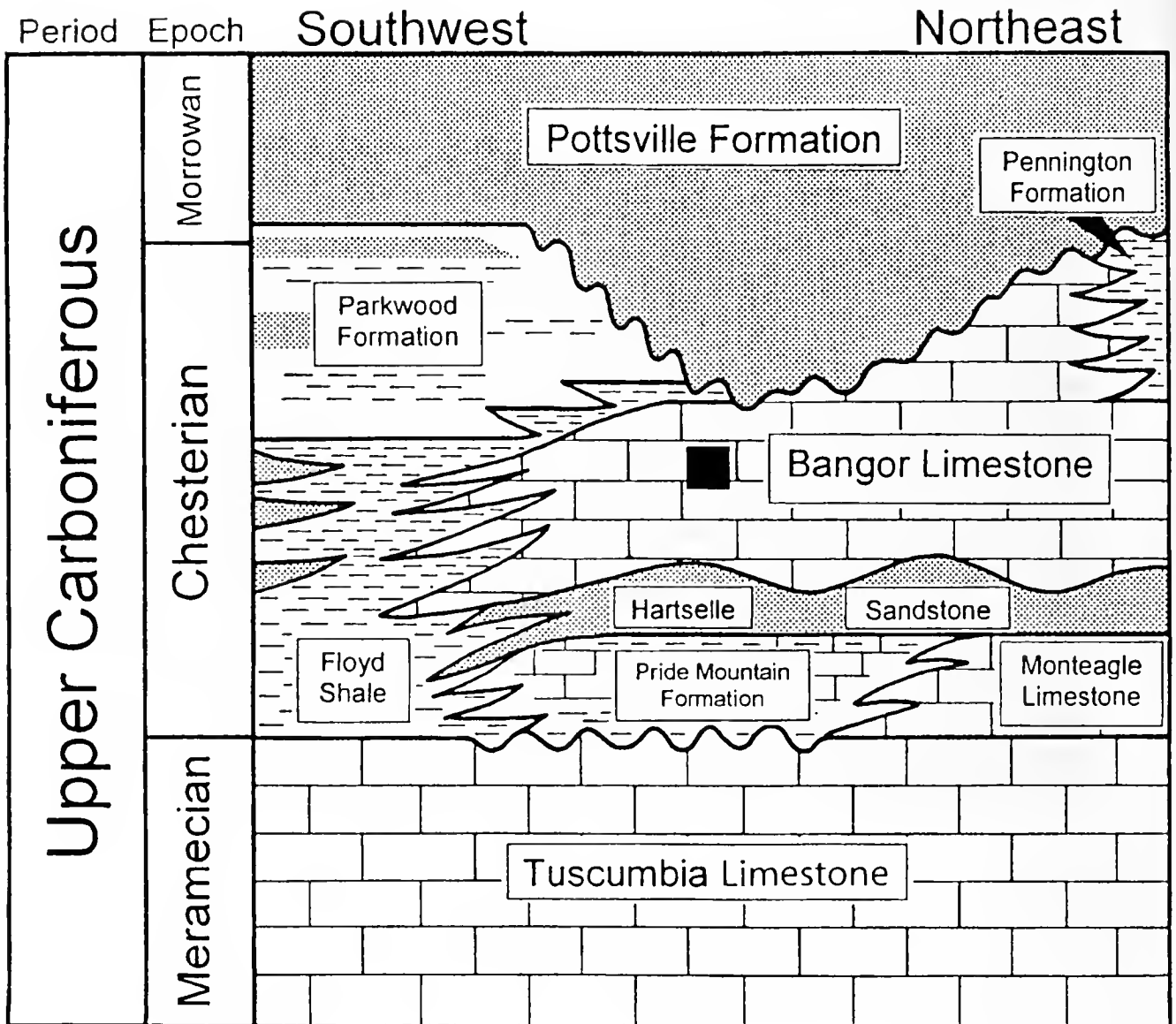
**Wackestone.** A carbonate rock in which particles are floating in a matrix of fine material.



**Figure 1.** Location of Bangor Limestone study site on Alabama State Highway 157 in Lawrence County, Alabama. The location of Blount County (study site of Andronaco, 1986) is also indicated. Generalized outcrop belt of Chesterian strata in northwest Alabama shown by brick pattern (modified by Kopaska-Merkel and Haywick, 2001, from Pashin, 1993).



**Figure 2.** Outcrop photograph (east side of Alabama State Highway 157) showing (A) the central core of the mound draped by (B) overlying more bedded facies. (Kopaska-Merkel and Haywick, 2001.)



**Figure 3.** Partial section of Upper Carboniferous strata in north Alabama. Approximate stratigraphic and paleogeographic position of the Lawrence County study site is indicated by the black square. (Kopaska-Merkel and Haywick, 2001.)

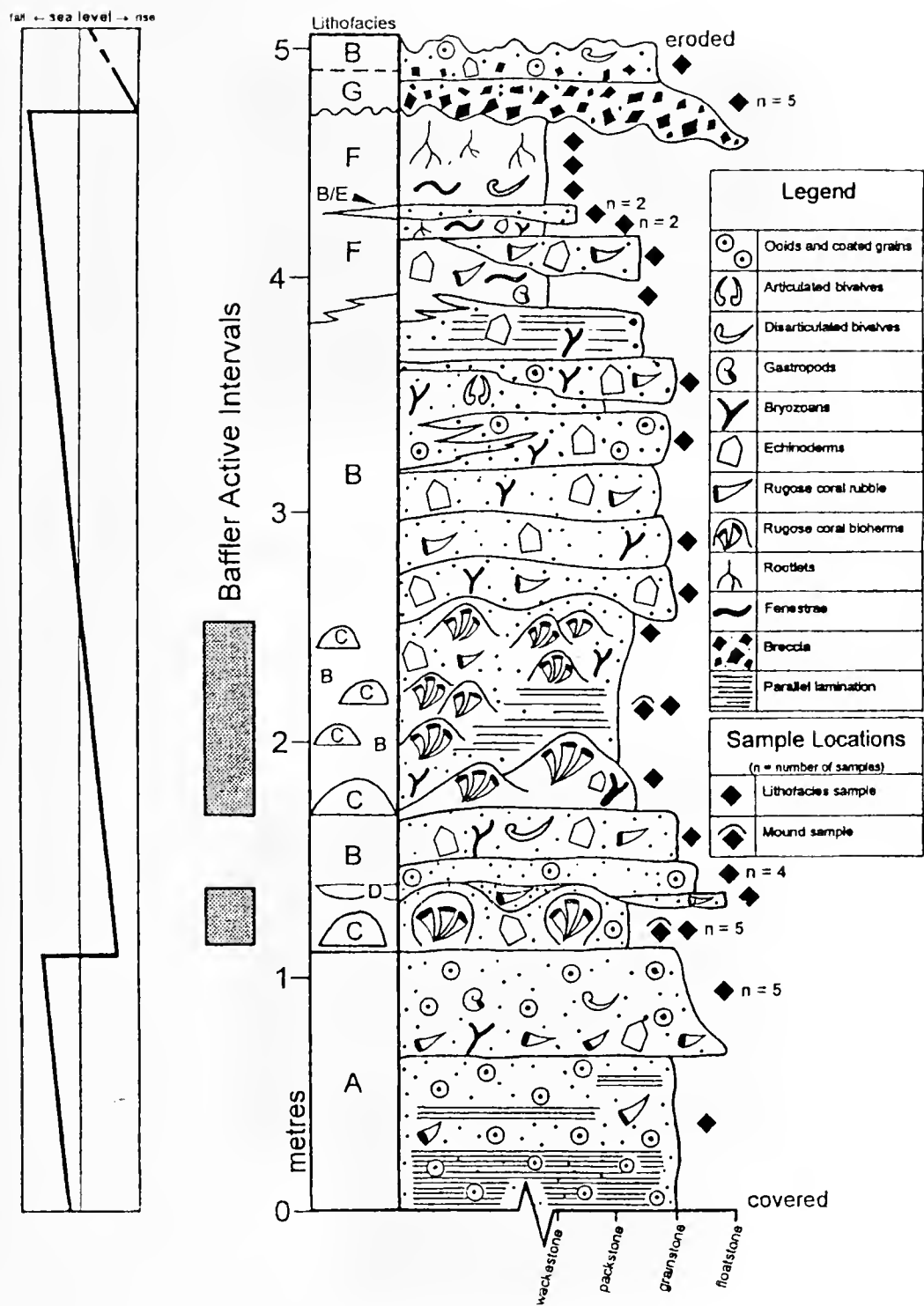


Figure 4. Schematic vertical section of the study site. (Kopaska-Merkel and Haywick, 2001.)

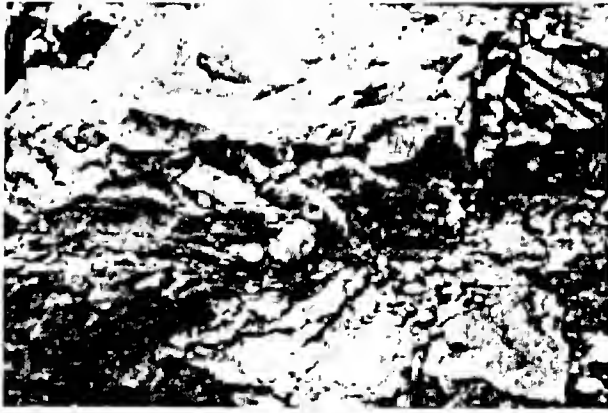


Figure 5. Thin-section photomicrograph of ooid grainstone with micropeloidal matrix.

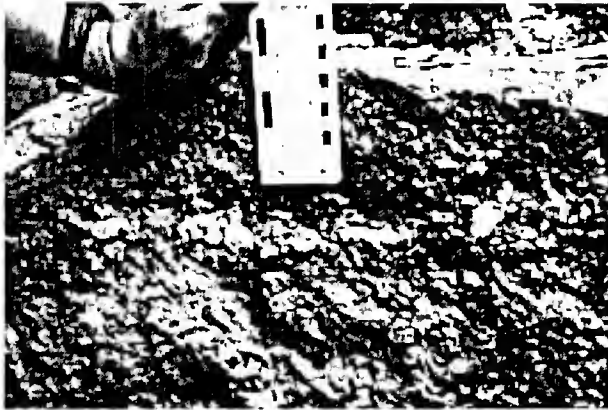


Figure 6. Colony of *Caninia flaccida*.





**Figure 7.** Coral Floatstone Lithofacies.



**Figure 8.** Breccia Lithofacies.

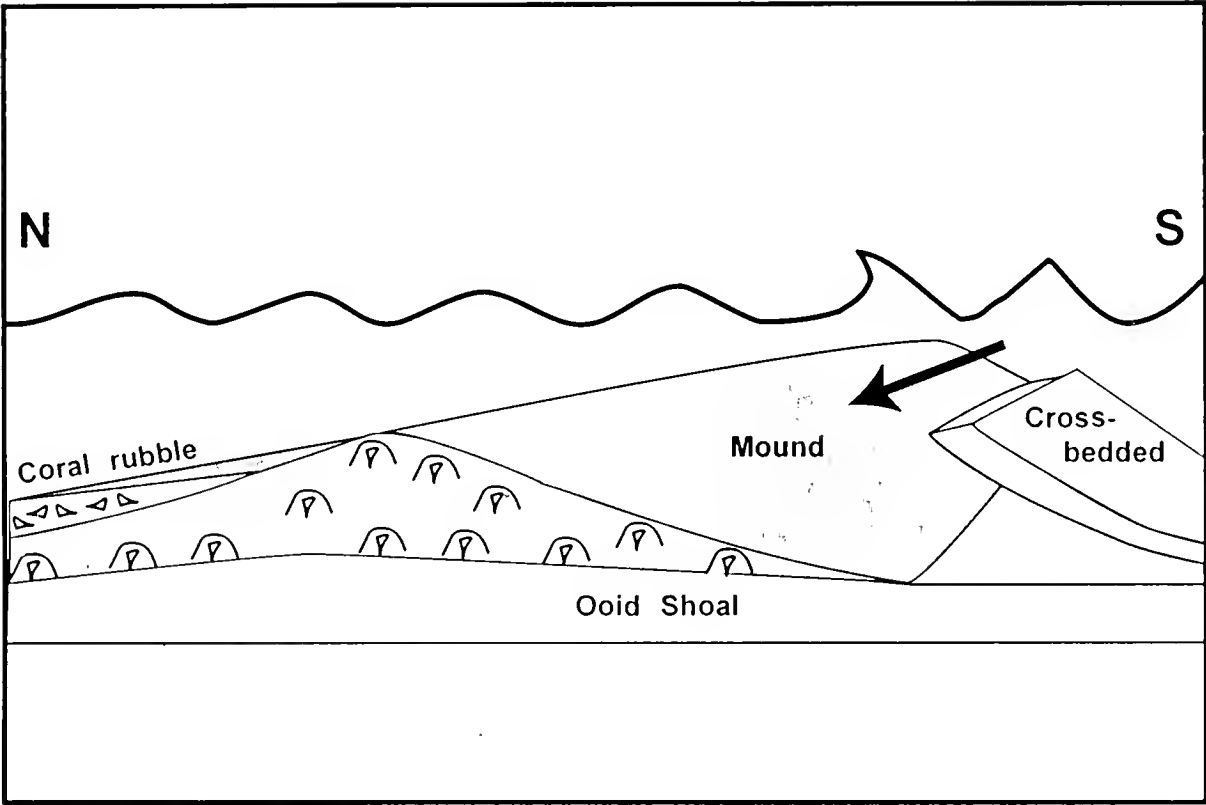
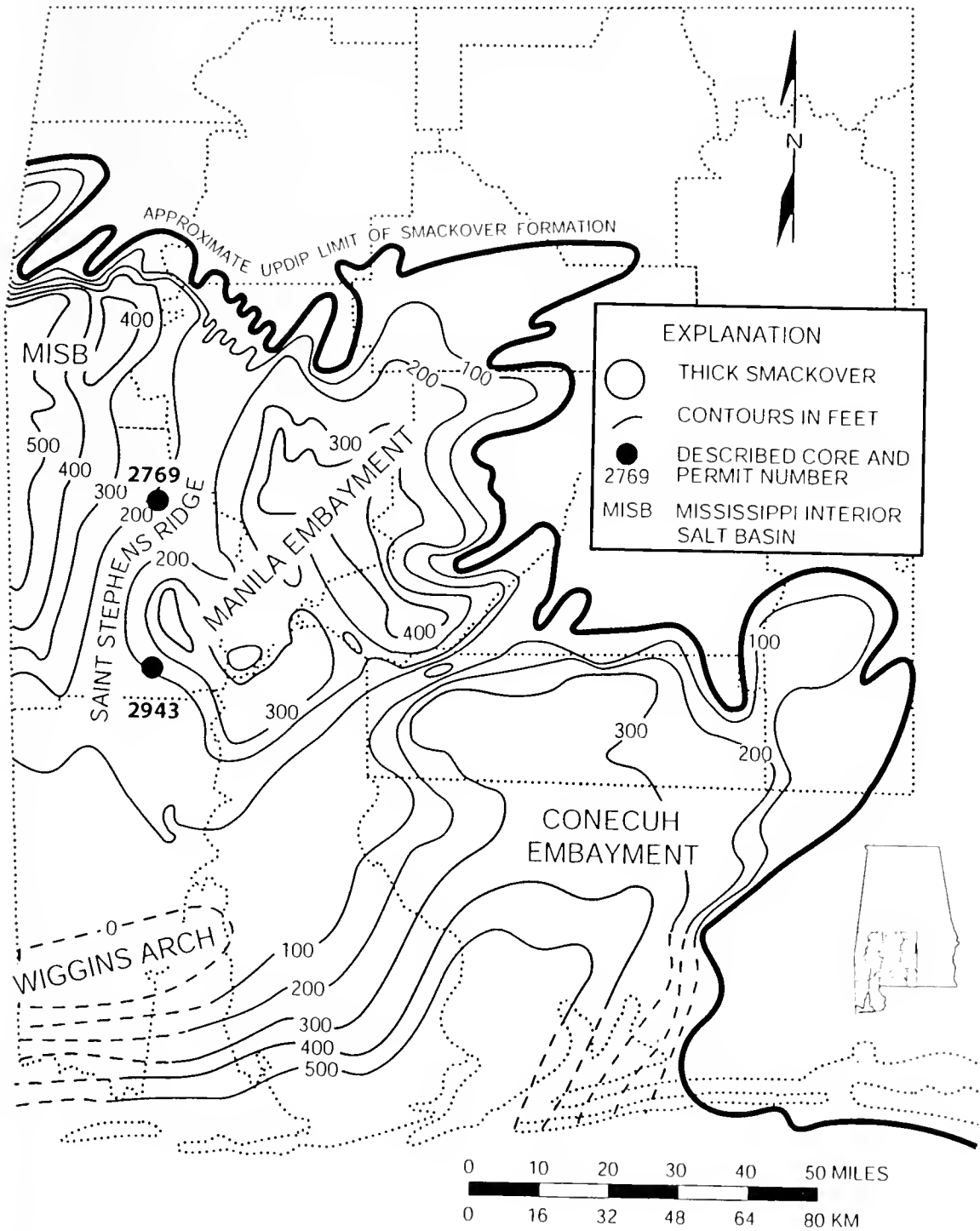
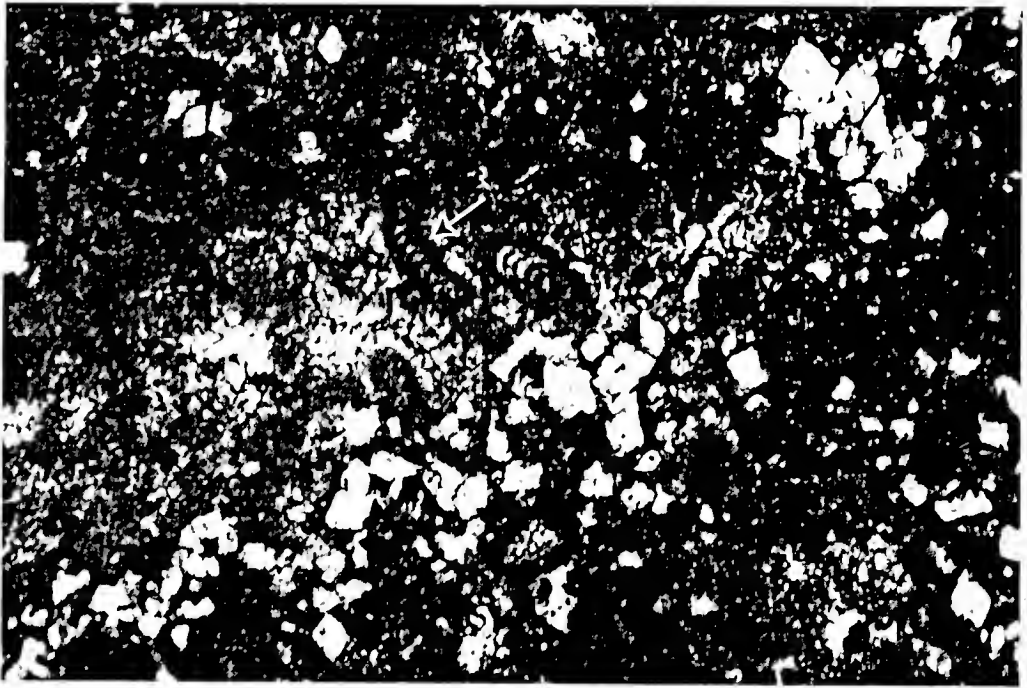


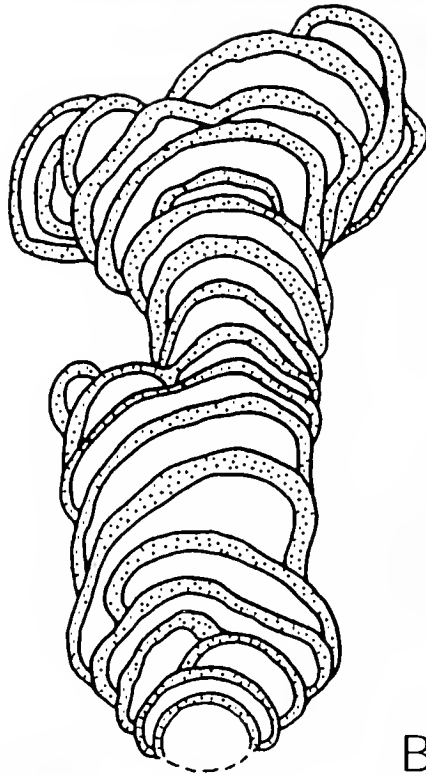
Figure 9. Schematic cartoon of mound.



**Figure 10.** Isopach (thickness) map of Smackover Formation, southwest Alabama, showing major depocenters and locations of cores described in this report (modified from G. V. Wilson, 1975, Fig. 6, and from Mancini and Benson, 1980, Fig. 3, and incorporating interpretations by G. V. Wilson and Michael Rogers).



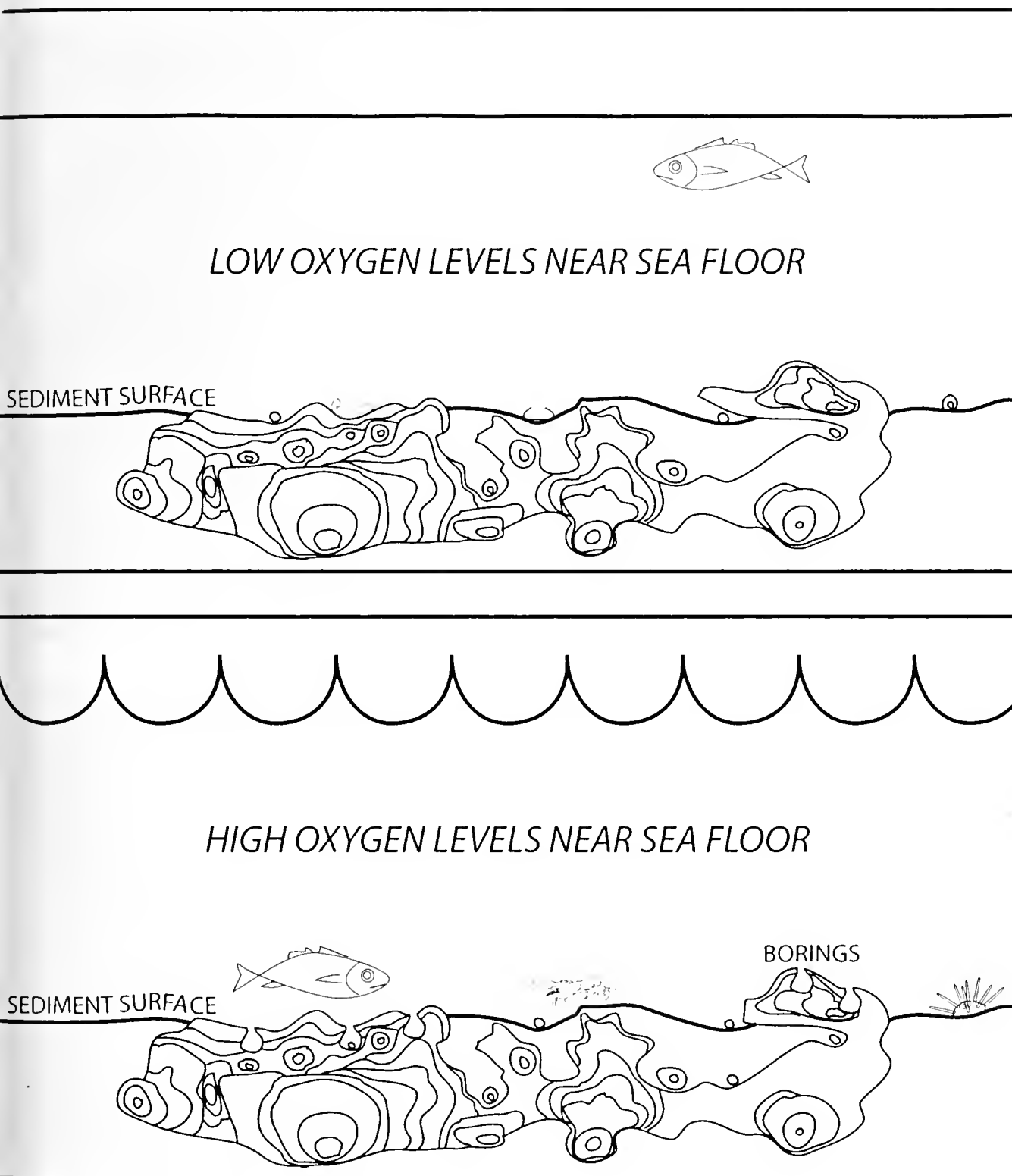
A



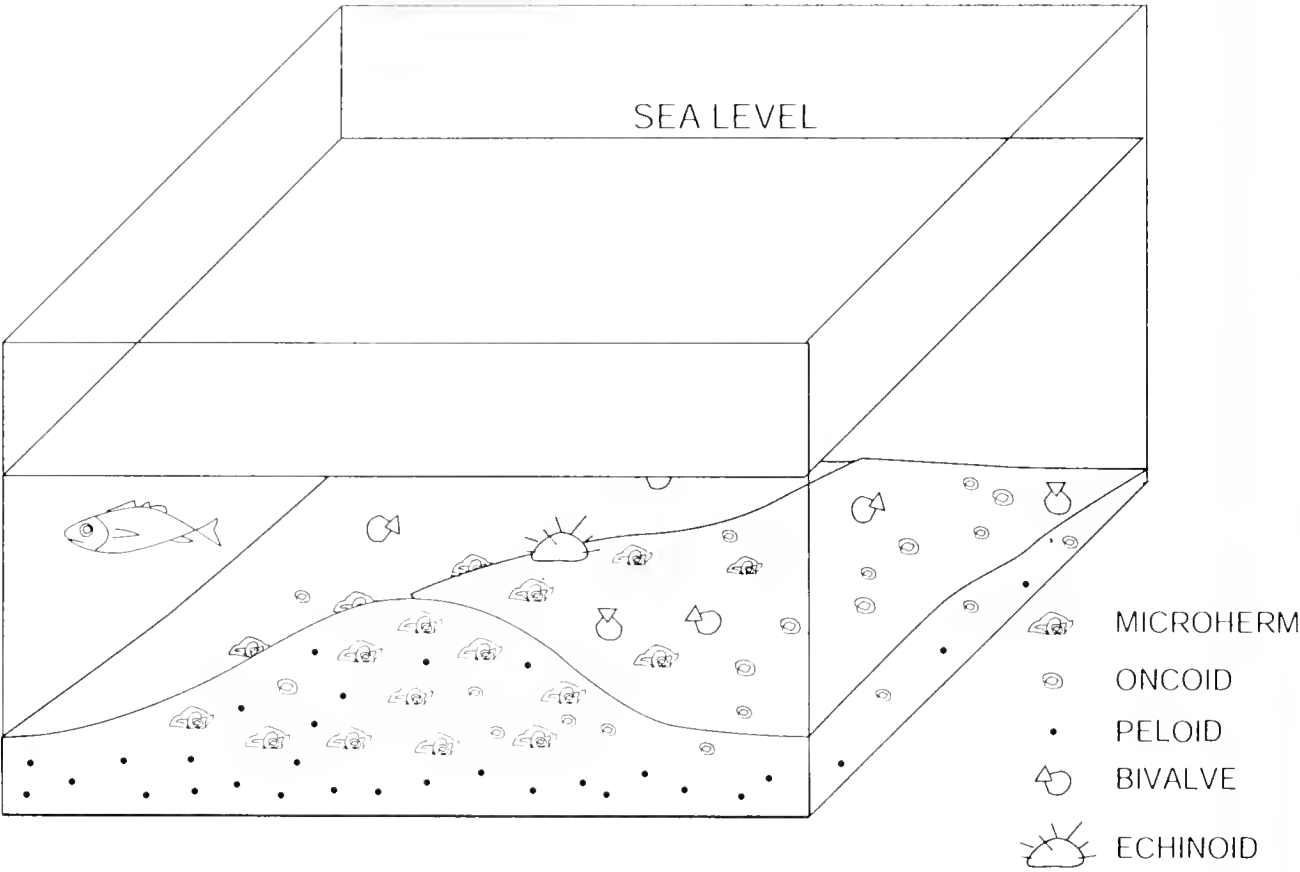
B

100 um

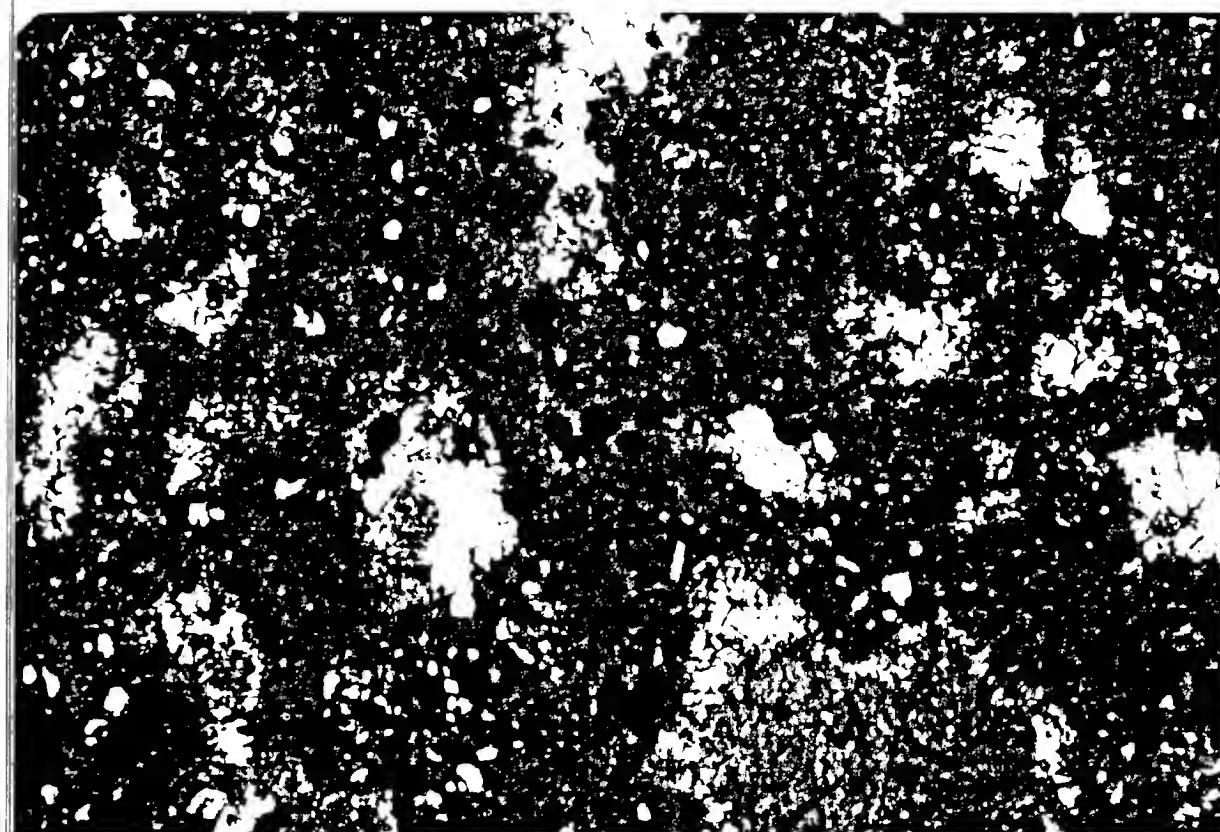
**Figure 11.** Renalcid species A. (A) Permit No. 2943, 6,024.6 m (19,765.9 ft.). Tubules growing down from upper surface of reentrant in microherm. Photomicrograph 1,000  $\mu\text{m}$  wide. (B) Schematic sketch of Y-branched specimen in longitudinal section (Kopaska-Merkel and Schmid, 1999).



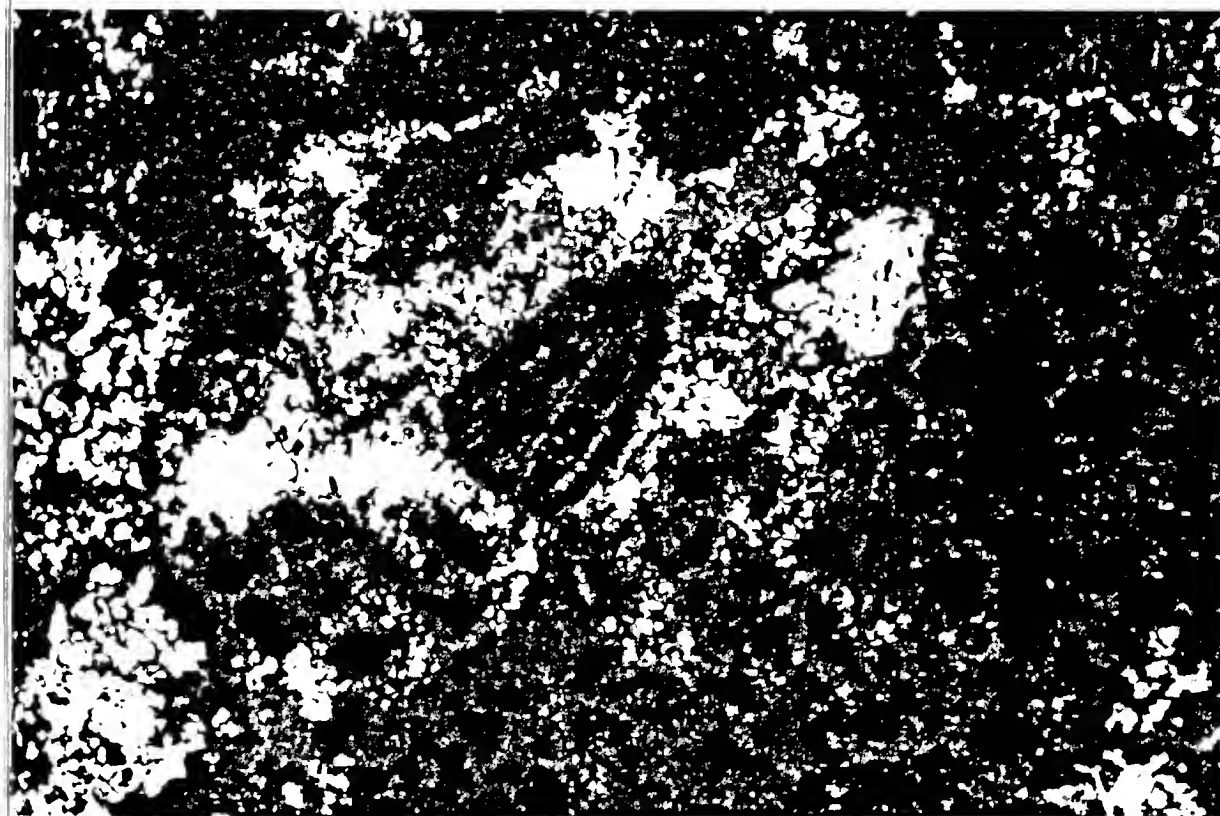
**Figure 12.** Schematic reconstruction of effect of bottom-water oxygenation on growth of microhermal biotrital mound.



**Figure 13.** Model of microhermal biodetrital mound (modified from Kopaska-Merkel and Schmid, 1999).



A

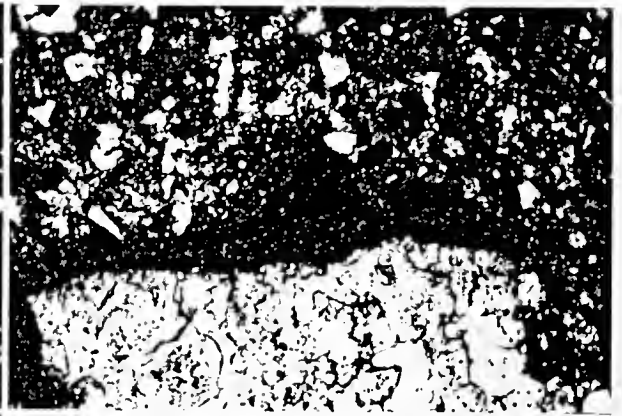


B

**Figure 14.** Thrombolite/stromatolite bioherm on north end of Saint Stephens ridge, State Oil and Gas Board Permit No. 2769, 2,500  $\mu\text{m}$  wide, oriented, A-C stained with Alizarin red S. (A) Thrombolite consisting of diffuse clots, fenestral, containing coccooid calcimicrobes (arrow), partially dolomitized, partially dedolomitized (embayed margins of dolomite crystals), 3,751.3 m (12,307.5 ft.). (B) Pelletal thrombolite overgrown by microsparitic thrombolite, with *Parafavosites* in fenestra containing partially dedolomitized planar-e dolomite, 3,751 m (12,306.3 ft.).



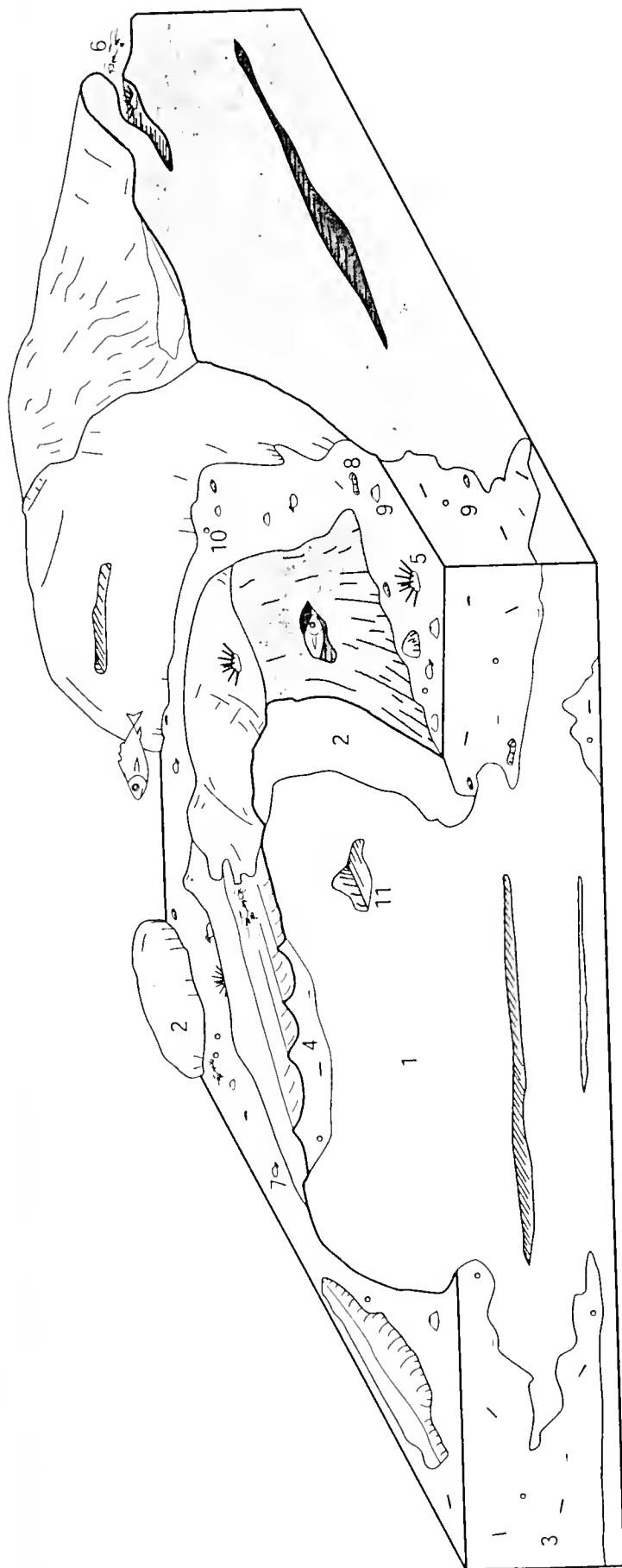
A



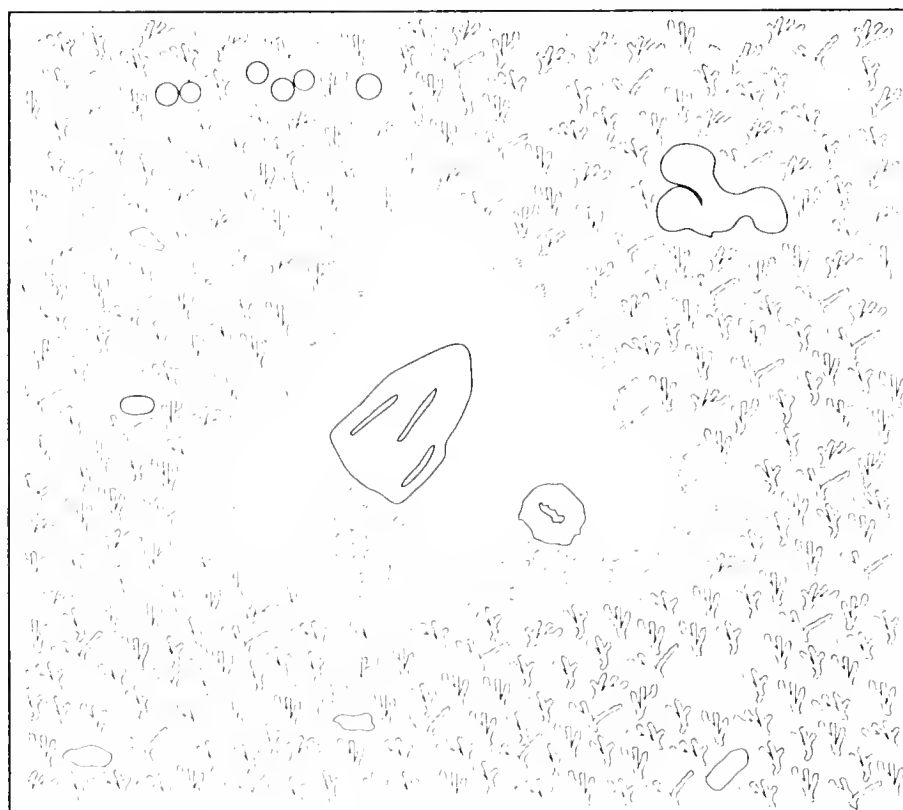
B

**Figure 16.** Microcrystalline encrustations on the walls of cavities within thrombolite, State Oil and Gas Board Permit No. 2769, 1,000  $\mu\text{m}$  wide, oriented, 3,749 m (12,299.9 ft.). (A) F, inclusion-rich spar in fenestra; E, microcrystalline stalagmitic carbonate probably precipitated by encrusting microbes; T, thrombolite "framework." (B) Microcrystalline encrustation on roof of fenestra.





**Figure 17A.** Reconstructions of Smackover carbonate mounds. Schematic block diagram of thrombolitic/stromatolitic mound, based on Wilson core, Saint Stephens ridge. Not to scale. 1, thrombolite; 2, stromatolite; 3, pack-wackestone; 4, grainstone, 5, echinoid; 6, thalassinidean shrimp; 7, bivalve; 8, bioherm debris; 9, thalassinidean burrow; 10, oncoid; 11, crypt. Many organisms that helped construct, or lived in or on, the Saint Stephens ridge mounds were microscopic, and hence are not visible at the scale of this illustration.

1,000  $\mu\text{m}$ 

## EXPLANATION

## THROMBOLITE FRAMEWORK



CALCIMICROBIAL TUFT

## OBJECTS WITHIN FRAMEWORK



FORAMINIFER



COCCOID CALCIMICROBE



SMALL OVOID FECAL PELLET



DETRITAL QUARTZ

## OBJECTS OCCUPYING FENESTRAE



FILAMENTOUS MICROBE



COCCOID MICROBE



BRANCHING FILAMENTOUS MICROBE



HELICERINA



PARAFAVREINA

**Figure 17B.** Reconstructions of Smackover carbonate mounds. Hypothetical microstructure of living thrombolite based on Wilson core. Thrombolite framework constructed by filamentous calcimicrobe ("calcimicrobial tufts"). Trapped or living within the thrombolite framework are foraminifera, coccoid calcimicrobes, fecal pellets, and detrital quartz. Fenestrae are lined with filamentous microbes preserved as microcrystalline laminae; clusters of coccoid microbes preserved as microcrystalline masses, and branching filamentous microbes preserved as inclusion-rich calcite. Some fenestrae contain fecal pellets.

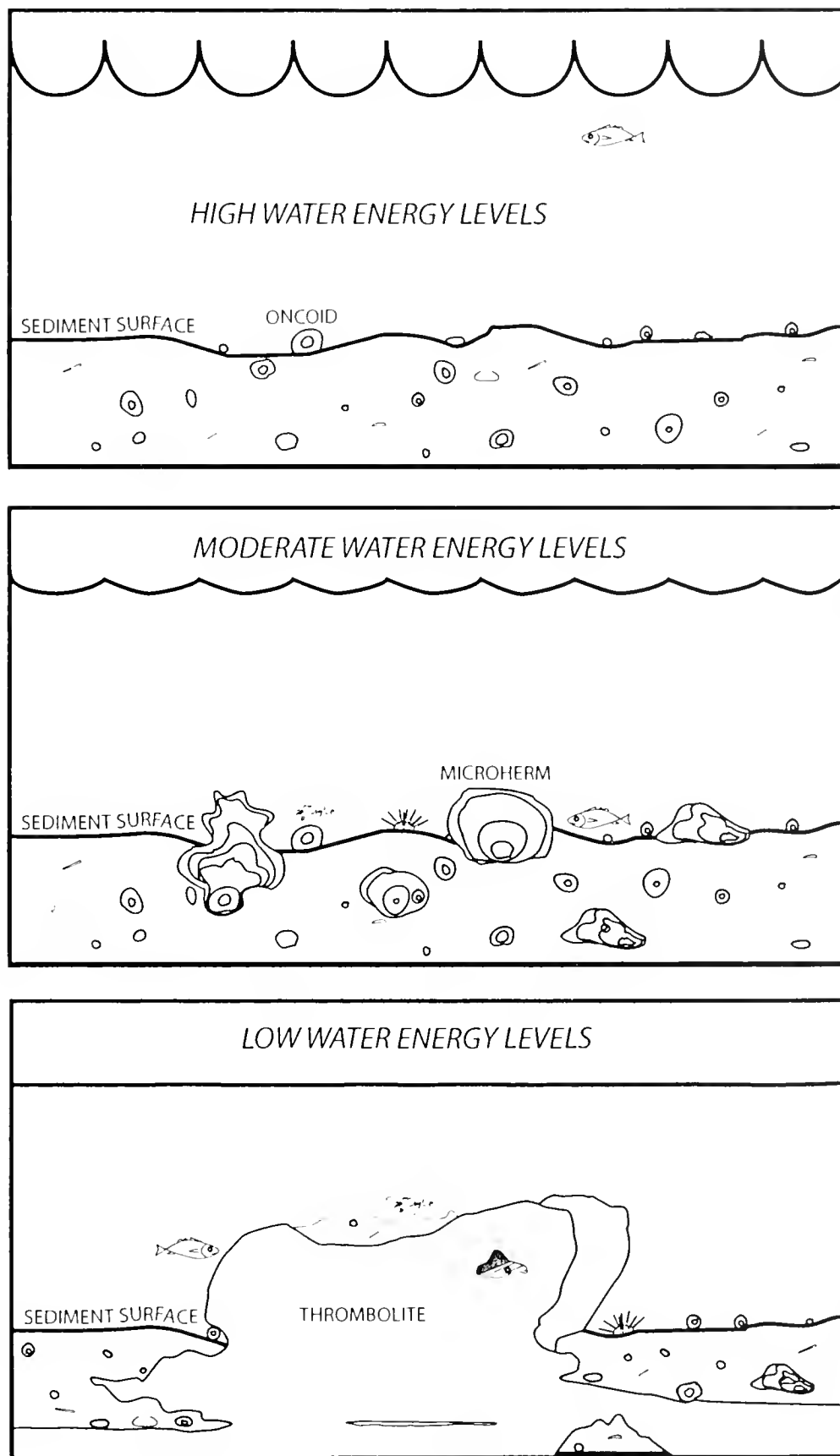


Figure 18. Schematic reconstruction of the effect of water energy on carbonate mounds on the northern part of the crest of the Saint Stephens ridge.

THE SCIENCE/POLICY DISCONNECT: THE ALABAMA AND  
MISSISSIPPI COASTAL EXPERIENCE\*

Larry E. Goldman  
U.S. Fish and Wildlife Service  
Daphne, Alabama

We live in a sometimes acidic environment regarding science and politics. The coastal areas of Alabama and Mississippi are places where these two factors sometimes do not mesh. Oft times, the fish and wildlife resources that I'm charged with protecting are caught in a dysfunctional "Catch-22" situation. This is an issue of considerable concern. I'd like to discuss some of those issues that are affecting the scientist, bureaucrat, and politician.

Some of the philosophical issues are:

1. Publish or perish-a long time dilemma that affects academia, government, coastal resources and management capabilities.
2. Accountability of higher education-the relevance of the institution to research, service, and teaching.
3. Doing more with less-the new fact of life for government agencies
4. Politics and biology-becoming more entwined every day
5. The proper role for the Federal government in relation to its citizens.

Two major questions that are germane to the issues are:

1. Is the scientific information needed for coastal resource management available?
2. Is the scientific information being used to manage resources effectively?

Two reports, prepared by blue ribbon panels almost three decades apart, examined coastal science and its use in resource decision making.

\*This was a contribution to the Coastal Symposium at the Annual Meeting of the Alabama Academy of Science, 1998.

**Report 1: Stratton Commission, Circa 1968**

“Each Federal agency concerned with the near shore waters should devote a considerably higher percent of its funds to basic research in the physical processes which shape our coast land and estuaries. This will insure the availability of essential knowledge necessary to plan and implement programs for their protection and preservation.”

You will notice that the word “insure” is highlighted. Another recommendation from that same report states:

“The nation should undertake and enhanced program of basic research into the dynamics of estuarine waters, the identification of specific pollutants and tracing of their effects, both on individual species and ecosystems, and on mechanisms through which organisms in ecosystems take up and accumulate various kinds of pollutants.”

**Report 2: National Research Council, Ocean Studies Board, Gulf of Mexico Symposium B1996 Proceedings: Improving Interactions Between Coastal Science and Policy**

“The information (coastal scientific information), if available would insure that there was an adequate basis for decision making.”

Two similar statements separated by almost 30 years, that constitute at least a partial report card on how well the challenges of meshing science information and decisions identified in the 60's have been met, present the clear picture of a shortfall. Making informed decisions today is probably much more important than it was 30+ years ago, but the payoff seems just as elusive.

The Northern Gulf Coast is being subjected to intense pressures that will determine its future character. We are now at a crossroads not unlike that faced by South Florida in the 50's and 60's or the Pacific Northwest in the 40's and 50's. The virtual collapse of the Everglades Ecosystem and the anadromous fishery of those two areas is stark evidence of the failure of natural resources decision making in those two areas. The price tag to fix those major mistakes will run into the billions of tax dollars.

What happened in those two areas and what can we learn from the mistakes? What role should science (and scientists) play in the decisions that lie before us along the North Central Gulf Coast?

“Those who do not learn from the mistakes of the past are doomed to repeat them”  
George Santayana, Philosopher-Historian

I would add that those in natural resources management who do not learn from the past not only condemn themselves with repeated mistakes, but they also condemn subsequent generations, for

## Alabama and Mississippi Coastal Experience

many development decisions of today involve irreversible and irretrievable commitments of natural resources.

Let's look at some science-natural resource decision-making problems that have been around for a long time:

1. There is too little science.
2. The available science is not very good or its value is uncertain.
3. Scientific information is not getting to managers.
4. Scientific information that gets to managers is ignored.
5. Scientific information is available but is not presented in a manner where it can be used in the decision-making process.
6. The public, particularly the key stakeholders, are not involved in the decision-making process and fail to understand either the facts or the process.
7. The scientific information used in decisions is viewed as having some uncertainty, but other inputs are presented as absolute.
8. The varied roles related to policy and scientific aspects of environmental management are too great for one person to fill. Most require a variety of participants who must respect each other's policies.

What are the positives affecting coastal resource decision-making?

1. State coastal zone management programs
2. Establishment of Estuarine/Marine Sanctuaries
3. Marine Mammal Protection Act
4. Clean Water Act
5. Oil Pollution Control Act
6. Comprehensive Coastal Wetlands Protection Act

These are significant programs that benefit the coast. I shudder to think of what the North Central Gulf Coast would look like without them; surely it would have substantially less environmental quality than it does now. However, we have problems now in this area which are not being adequately addressed by these programs.

Three major economic forces are operating in the area that are capable of changing the character of the region. They are:

1. Casino development in Mississippi
2. Gas/oil/chemical industry
3. Residential/condominium development

These issues are on the front burner every day in the two states. Either these economic stimulants or their spin-offs, present challenges to Federal, state, or local officials on a constant basis. Over a dozen casinos operate along the Mississippi coast. What started out to be a riverboat operation has boomed into billion dollar investments that feature "destination resort" approaches that bring

the industry's impact from the waterfront to the upper headwaters of the coastal streams. Coastal ecosystems are under rapidly mounting pressure. Housing starts in coastal Mississippi increased by 250% from pre-casino levels in 1992 to 1998. Golf courses, shopping malls, subdivisions, and all the other things associated with destination resort development are being constructed.

The oil/chemical industry has gone from nothing to a major land user in south Mobile County, Alabama in less than 20 years. Refineries, pipelines, shipping terminals, and all other support industries now dominate the landscape.

Baldwin County, Alabama experienced a 30+% growth rate during the 1990's, the second fastest in the state.

These large-scale human pressures on the natural environment have led to the following issues that affect the quality of coastal environments.

1. Water quality problems in coastal Mississippi streams and bays
2. Overloaded wastewater treatment plants
3. Absence of septic tank regulatory programs
4. Monitoring shortfalls for coastal water bodies
5. Inadequate standards for coastal water bodies
6. Apparent violations of dissolved oxygen and coliform bacteria standards
7. Development on beach and dune areas
8. Long term water supply and stream flow concerns

Who makes the majority of coastal resource management decisions? Local government makes the following key decisions that affect the coastal areas:

1. Development
2. Sewers
3. Transportation/infrastructure
4. Utilities
5. Set backs
6. Zoning
7. Septic tanks
8. Drainage

These are major decisions when viewed in a cumulative sense. They serve to "cast the die" for future coastal conditions. They dictate the future more so than decisions by either state or federal governments. These decisions are often the most removed from the presence of important scientific information. While a few local governments have staff dedicated to planning (including some very capable professionals), it is very rare to find an on-staff scientific capability. Therein lies one of the main reasons for the disconnect between science, policy, and decisions. The necessary links to bring these crucial elements together are either not in place or they are not well formed up. Contrary to the findings of the "blue ribbon commissions", merely having the information has not insured its use in decisions about the future of the coast.

## Alabama and Mississippi Coastal Experience

There's an old saying that goes like this: "If you're not part of forging a solution to a problem, then you are part of the problem".

If we as scientists are interested or committed to retaining the natural values of the coastal area, then we must bring science to the local decision-making process. This job does not get done by scientists talking to scientists. We've got to build a bridge to get the information from the scientist to the local decision-maker.

Here are some possible ways to bring the science and the decision-maker together:

1. Events -- the Dauphin Island Sea Lab has sponsored workshops on coastal issues specifically designed to bring scientists and decision-makers together.
2. Programs -- Collaborative efforts like the Mobile Bay National Estuary Program forces scientists, regulators, and government officials to work together and talk about the future of the coastal area.
3. Customized outreach tools -- There is a lot of potential for academia, government, and industry to try and tap the research and knowledge available to help produce wider recognition, awareness, and understanding of key coastal resource concerns.

The future of the coastal area is now in the balance. Will we follow down the road of south Florida and repeat those costly mistakes, or will we do what is needed to make conscious and informed choices?



## GORGAS SCHOLARSHIP AWARDS

March 29, 2002

Today the Gorgas Scholarship committee announced the rankings of the finalists of the 2002 Alabama Science Talent Search. The Search was held at the meeting of the Alabama Academy of Science at the University of West Alabama, Livingston, Alabama.

The winner of the first-place tuition grant of \$4000 was:

Bryce Leitner Roberts, 4215 Overlook Road, Birmingham, AL, 35222, Mountain Brook High School, Birmingham, AL, 35223, Teacher-Ms. Sophia Clifford.

First alternate and winner of a tuition grant of \$3000 was:

(F) Nicole Anne Oertli, 1601 Fern Rock Circle, Mobile, AL, 36695, Murphy High School, Mobile, AL, 36695, Teacher-Wanda Griffis.

Second alternate and winner of a tuition grant of \$2000 was:

Jordan Thomas Farina, 110 Cedar Point Drive, Killen, AL, 35645, Brooks High School, Killen, AL, 35645, Teacher-Ms. Wanda Phillips.

Third alternate and winner of a tuition grant of \$1500 was:

(S) Rebekah Lee Rogers, 125 Lancaster Road, Florence, AL 35633. Bradshaw High School, Florence, AL, 35630, Teacher-Mrs. Shannon Upton.

Fourth alternate and winner of a tuition grant of \$1000 was:

Evan Marshall Thomas, 2020 Cameron Road, Huntsville, AL, 35802, Grissom High School, Huntsville, AL, 35802, Teacher-Ms. Peggy Murray.

(F) National Finalist, (S) National Semi-finalist

### Unranked Finalists

Alexis Janean Adams, 6001 Cherokee Hill Drive, Huntsville, AL, 35810, J.O. Johnson High School, Huntsville, AL, 35810, Teacher-Ms. Melonie Hanson.

## Gorgas Awards

Kevin Michael Alexander, 10 Moss Rock Lane, Birmingham, AL, 35210, Jefferson County International Baccalaureate School, Birmingham, AL, 35210, Teacher-Ms. Debbie Anderson.

Matthew James Bradford, 741 County Road 33, Killen, AL, 35645, Brooks High School, Killen, AL, 35645, Teacher-Ms. Vicki Farina.

Willie Griffin Jr., 6105 Trent Drive, Huntsville, AL, 35810, J.O. Johnson High School, Huntsville, AL, 35810, Teacher-Ms. Melonie Hanson.

Tiffany R. Truss, 913 23rd Court Northwest, Birmingham, AL, 35215, Alabama School of Fine Arts, Birmingham, AL, 35203, Teacher-Ms. April Miller.

The rankings were established by a panel of judges consisting of department heads, deans and professors from many of the leading universities and industries in Alabama. Winners and finalists in the Gorgas Contest receive offers of tuition scholarships to colleges and universities in Alabama for the study of science. The Gorgas Scholarship Program is named for General William Crawford Gorgas, the Alabama physician who conquered yellow fever in the Panama Canal Zone and later became the Surgeon General of the United States Army. The purposes of the Gorgas competition are to promote interest in science and to aid in the education of promising students.

**Minutes**  
**AAS Spring Executive Committee Meeting**  
**Student Union Building**  
**University of West Alabama**  
**Livingston, Alabama**  
**March 27, 2002**

President Roland Dute called the meeting to order at 7:32pm. The Secretary did not have the minutes of the Fall Executive Committee meeting (October 20, 2001) available, so their approval was tabled until a later date, or publication in the *JAAS*.

**Officer Reports (B)**

1. There was no report from Dr. Eugene Omasta and the **Board of Trustees**
2. **President** Roland Dute discussed the following activities as part of the duties of his office: **(a)** helped with 2001 post-meeting considerations at Auburn University; **(b)** worked with Dr. Holliman to set up Fall Steering Committee meeting; **(c)** alerted members to the Fall and Spring Executive Committee meetings; **(d)** sent congratulatory letter to Dr. DeVall (former AAS President) for his 20 years of service with Service Corps of Retired Executives; **(e)** sent thank-you letter to Dr. Neal R. Berte, President of Birmingham-Southern College, for support the Fall Dinner of the Steering Committee; **(f)** sent a memo on behalf of the Academy to the Alabama Board of Education regarding the textbook disclaimer; **(g)** provide Welcome statement for the annual meeting brochure; **(h)** provided suggestion to Anne Cusic (second vice-president) for candidates for elected office; **(i)** wrote banquet program for the meeting. President Dute indicated that other items in his report had appeared in the minutes of the Fall Executive Committee meeting.
3. **First Vice-President and President-Elect** Stephen Watts submitted the following report: **(a)** I worked with Anne Cusic to fill some of the vacancies involved in several committees; **(b)** in working with Richard Hudiburg, Roland Dute, and Anne Cusic, we have established the on-line ability to apply for travel awards and research grants, and register for the paper/poster competition. The historical names of these categories were changed to minimize confusion. The procedures were tested in advance and I would suggest they were successful. The next issue will be on-line registration and payment of dues; **(c)** with the help of Dail Mullins, we were able to solve the case of the "naked lady poster" at the McWane Center in Birmingham. Complaints were lodged with the Academy by a member of the general public that certain anatomical features were being "covered" at the Center. We were able to resolve this problem to the mutual satisfaction of all parties; **(d)** worked with Anne Cusic, Roland Dute and Dail Mullins to redesign the dues cards to allow for multiple-year options. It seems to have been successful; **(e)** I currently serve as the representative to the American Association for the Advancement of Science (AAAS) and have had several contacts

with the association (see report below); **(f)** we have instituted an informal policy by which all communications concerning the Academy are forwarded to the members of the Executive Committee (President, First Vice-President, Second Vice-President, Secretary) so that we can all be aware of any problems or issues as they arise, work together to solve these issues, and increase our general understanding of the workings of the Academy. This was quite effective and was invaluable, in particular, when working with the University of West Alabama in developing the spring meeting. We suggest this level of communication continue in future administrations; **(g)** I will be working with Roland Dute and Anne Cusic to insure communication and a smooth transition among the current officers of the Academy; **(h)** I would like to extend a special thanks to Don Salter and his colleagues who have done an outstanding job in preparing for the Spring meeting at the University of West Alabama.

4. The **Second Vice-President**, Anne Cusic, submitted the following report: The duties of the Second Vice-President are (1) to become familiar with the organization and working of the Academy, and (2) serve as Chair of the Nominating Committee. During the past year, I have worked with the President and the First Vice-President to understand the structure of the Academy. I have worked with the First Vice-President to learn the duties of that office, which I will hold next year. The President and the First Vice-President have included me in several discussions concerning topics related to the Academy. I have studied the Constitution and By-Laws to familiarize myself with the organization. I have assisted the Chair of the Research Committee and the elected Chair of the Membership Committee with understanding the workings of those committees. The majority of my time has been spent finding nominees for the offices that are open (addressed in the report from the Nominating Committee, below)
5. The **Secretary**, Dail Mullins, submitted the following list of activities as part of the duties of that office: **(a)** transferred all checks/cash received for dues to the Treasurer after recording information on the master roll (kept by Kathryn Pitt); **(b)** provided the Editor of the *JAAS* with membership rolls and mailing labels as requested; **(c)** made requested mailing address and/or email address changes to the master roll upon receipt of information from individual members; **(d)** provided membership rolls/lists to Section Heads as requested by them or the Executive Officer; **(e)** submitted minutes of the Fall AAS Executive Committee meeting (October 20, 2001) to the Editor of the *JAAS* as requested; **(f)** corresponded with several out-of-state individuals about joining/renewing membership in AAS. I also request the Executive Committee's advice on the best means for notifying members—especially new members—that we have received their application form and dues payment. This seems to be an issue mainly for people who receive a second dues notice after having responded to the first, or whose check is not deposited for some weeks. I have begun responding to received application forms via email when this address is available, but many applicants do not provide this information.

## Minutes

6. Larry Krannich, the **Treasurer**, submitted the following summary report, accompanied by a number of relevant color-coded documents: Total account balances as of 12/31/01 were \$75,812.83. Although the Academy budgeted a deficit of \$8,665, the year ended with a surplus of \$732.09. The major reasons for this are the receipt of the revenues for the 2000 Annual Meeting (Samford University) and 2001 Annual Meeting (Auburn University) in calendar year 2001 and a healthy dues collection during the fourth quarter. Interest, Journal, and Mason fund incomes were greater than projected. While the Journal costs exceeded our projections, grand and officer expenditures were under budget. No income or expenditures relative to the Science Olympiad occurred during 2001. For 2002, we are operating with a budget that mirrors the 2001 budget, except for the State Science Fair, wherein all funds associated with the International Science and Engineering Fair are channeled through the Alabama Academy of Science. Income and expenditures are tracking what is expected for the first quarter of a fiscal year. In short, we do not expect any unforeseen budgetary problems during 2002.
7. The **Journal Editor**, Jim Bradley, submitted the following report: Publication of the *JAAS* is nearly back on schedule. The October, 2001 issue is at the printer, and the January, 2002 issue is being assembled. Published during 2001 were 13 research or symposium articles, 2 book reviews, and 118 abstracts from the annual meeting. I have been in communication with Eugene OMasta about how to meet the expenses of publishing the Journal. We have discussed additional sources of revenue that could be applied to publishing the journal such as increased dues and an abstract handling fee. We also have discussed how approximately \$2600/year could be saved by publishing only three issues, rolling the abstracts into a combined April/July issue (which could also include the Symposium papers). To save this amount of money would require giving up the 4-color cover photo and returning to a cover containing text only. Presently, each color photo cover costs about \$1000, and the glossy paper used for the text of the journal costs \$32/page. Changing to a non-glossy paper would save only \$2/page. Presently an average issue contains 80 pages. My recommendation is to go to 3 issues/year as described above, change back to a text-based cover, and retain the glossy pages. I have learned that the AU Library's approximately \$4500/year support for the publication of the *JAAS* is a line item from the State of Alabama into the Library's budget each year. This means that we can count on it continuing. The Library pays the postage for mailing of the journals in addition to the \$4500, and this too appears as though it will be continued indefinitely.
8. B. J. Bateman, the **Counselor to AJAS**, had no written report. He indicated that AJAS had a low attendance ( $< 45$ ), speculating that this was due to Spring Break.
9. Virginia Valardi, **Science Fair Coordinator**, was unable to attend the meeting – no report.
10. Jane Nall, **Science Olympiad Coordinator**, submitted the following written report: Three Elementary Science Olympiad tournaments were scheduled this year. A total

## Minutes

of 47 teams registered. Hosting schools included Geneva High School, Jacksonville High School, and Auburn University. Institutional faculty, staff, students and volunteers from 5 universities hosted Division C (grades 9-12) tournaments, and 4 of these schools also hosted tournaments for Division B (grades 6-9). A total of 86 B teams and 76 C teams registered to participate in Alabama Science Olympiad 2001-2002 at Auburn University, Jacksonville State University, UA, UAH, and USA. Based on the membership on December 1, 2001, a total of 17 B teams will advance to the Alabama Science Olympiad Division B Tournament on April 6, 2002, hosted by Huntingdon College in Montgomery, and 16 C teams will compete at Samford University in Birmingham on April 13. Two teams from each state tournament will earn the invitation to compete in the National Science Olympiad Tournament on the campus of the University of Delaware in Newark, Delaware, May 17-18, 2002. Participation in the Alabama Science Olympiad continues to rank in the top 10 for numbers of registered teams in the U.S. and Ontario. Additional hosts, especially for both Division A (Elementary) and Division B (grades 6-9) are needed. The director is also seeking financial assistance to provide coaching clinics and workshops in two areas of Alabama where Science Olympiad is not represented by teams or institutions hosting tournaments. Under consideration is inviting schools never having been members in Science Olympiad to receive a reduced registration fee and compete in a tournament one time. Registration fees for Alabama Science Olympiad teams will be the same as this year from May 15-November 1, 2002, but increase after November 1. No registrations will be accepted after December 15, 2002. The webmaster, David Peters, continues to maintain the Alabama Science Olympiad web page, which receives many compliments from people across the United States. It is updated as often as necessary, and continues to be a valuable resource. Director Nall is most appreciative of all those involved in providing "science at its best" to the student of Alabama.

11. **The Counselor to the American Association for the Advancement of Science (AAAS)**, Stephen Watts, submitted the following written report: The AAAS met for its annual meeting in Boston, MA on February 15, 2002. We are members of the Section on Agriculture, Food and Renewable Resources. New officers were elected. Several symposia were approved for the next meeting, including "Farm Crisis: How the Heck Did We Get There?", "Biotechnology Policy in Europe and North America," and "The Search for a Common Future: Communicating About Global Sustainability." Various reports from different national organizations were presented at the meeting, and are available by email.
12. **Section Officers** – written reports were submitted from the following Sections:
  - **I. Biological Sciences** – There are 28 oral (including one withdrawn) and 12 poster presentations scheduled in the Biological Sciences Section at the 2002 meeting of AAS at the University of West Alabama. The oral presentations are grouped into 3 sessions on Thursday morning, Thursday afternoon, and Friday afternoon to accommodate the Friday morning Symposium. The poster presentations will be given on Friday afternoon along with those from several other Sections (Don Salter)

- **IV. Industry and Economics** – Last year, Paulette Alexander served as Section Chair and Eric Rahimian served as Co-Chair. In the 78<sup>th</sup> Annual Meeting program, 12 papers were listed for presentation, but 2 members did not attend so only 10 were presented. The announcement of the 79<sup>th</sup> Annual Conference was widely distributed by the Chair and Co-Chair. As a result, more participants have submitted titles for presentation and, hence, more papers (15) are listed in the program for the session tomorrow. We feel that place, time, and how the papers are published (abstract or full paper in the Proceedings) are important factors in recruiting new participants and the percentage of people who will attend the Conference (Eric Rahimian, Linda Carr)
- **VIII. Behavioral and Social Sciences** – There are a total of 15 papers scheduled for presentation at the 2002 AAS Meeting. This is an increase of 2 papers from the 2001 meeting. To solicit participation this year, meeting announcements and letters requesting submissions were sent to all current section members and presenters on last year's program. In an attempt to increase participation in the Academy and at this year's meeting, these materials were sent to several departments at all colleges and universities in the state. In addition, to recruit from Auburn University, these materials were sent to individual faculty in all departments of sociology, criminology/criminal justice, economics, political science, social work, psychology, and human development and family studies (Janice Clifford Wittekind, Arthur Wilke)

13. **Executive Director** (Lev Hazelgrove) presented his written report: Since the Fall Executive Meeting, 20 October 2001 at Southern Research Institute we have been working on the following projects during the last five months:

1. Set up and prepared the Gorgas Scholarship Program for Science Talent Search in cooperation with the Westinghouse (now Intel) Scholarship Science Service, Inc., D.C., for the University of West Alabama, 29 March 2002 meeting with the leadership of Dr. Ellen Buckner, Co Chair, and Dr. Don Salter, Local Chair. This year we had a student place in the top 40 in the USA as a FINALIST – 2002! With a week in D. C. as guest of INTEL!
2. Prepared for bulk mail 800 "Call for Paper Titles" for the University of West Alabama meeting for March 27, 2002, edited by Dr. William J. Barrett, out 14 November 2001.
3. Ordered from EBSCO the Gardner plaque for Wayne H. Finley, M.D., Ph.D., and Sara C. Finley, M.D., Co-Chair, with the selection by Dr. Prakash Sharma, Chair, Wright A. Gardner Award, who is in India visiting his ill father.
4. Prepared two Carmichael Awards with the recommendation of Dr. Velma Richardson, UAB Medical School Chair, Emmett B. Carmichael Award Committee, with checks to each by Dr. Larry K. Krannich, AAS Treasurer
5. 6 July 2001 site visit with Dr. Don Salter and his local committee for the AAS dates: March 27-30, 2002, at UWA with Drs. Dute, Omasta, Bateman, Watts and Buckner.

6. Prepared 12 abstracts for the UWA meeting, March 28-31, 2001 for eleven section chairs and advised return by 23 March 2002 to Dr. Bradley.
7. Your Director studied flora, fauna and pollution in the USA, 14, 15, 16, February 2002, with the Alabama Fisheries Association at Gulf Shores State Park with Drs. Marion, Angus and Watts!
8. Worked for the International Science & Engineering Fair, May 11-18, 2002, in Louisville, KY with leadership of Mrs. Virginia Vilardi, Wetumpka H. S., Wetumpka AL, 36092, 334.567.5158 or Cell 334.315.4594, FAX 334.527.1178 and the able help of Dir. Mgmt. James R. Lowry, UAB!
9. Prepared the printed program and mailed 800 copies by snail & with the help of Dr. Hudiburg put it on the net and the Editorship of Dr. William J. Barrett, Past President and Chairman of the AAS Board Emeritus!

### Committee Reports (C)

1. **Local Arrangements (Don Salter)** – We believe that we are ready for the 79<sup>th</sup> Annual Meeting of the Alabama Academy of Sciences and the Annual Meeting of the Alabama Junior Academy of Sciences and Gorgas Scholarship Committee.
  - Lunch (cost covered by registration fee) is scheduled for AAS and AJAS participants in the UWA Cafeteria from 11:30-1:15 on Thursday and Friday
  - A catfish social (cost covered by registration fee) for AAS and AJAS participants is scheduled for Thursday, March 28 at 6:00pm in the Livingston Community Civic Center. The local arrangements committee appreciates the leadership of Mr. Micky Smith, Department of Mathematics, in arranging this important function
  - Registration for AAS participants on Wednesday evening, Thursday, and Friday has been scheduled for the Hallway of Webb Hall near the Parlor. Materials reminding participants of the various social and scientific activities have been included in their registration packets
  - Continental breakfasts (cost covered by registration fee) for AAS participants have been scheduled for the adjacent Brock Hall on Thursday and Friday mornings
  - Registration for JAAS has been scheduled on Thursday afternoon and Friday morning in the lobby of nearby Livingston Motel where most of the participants will be staying
  - Continental breakfast (cost covered by AJAS and registration fee) for AJAS has been scheduled for the Second Floor Foyer of Wallace Hall on Friday morning. The participants are responsible for their own breakfast on Saturday morning
  - Gorgas Scholarship competitors, organizers, and judges can obtain their nametags, banquet tickets, and other material in Room 412 of Wallace Hall on Friday
  - All scientific meetings of the AAS have been scheduled for rooms in Bibb Graves Hall. Permanently mounted Power Point projectors have been installed in four of the meeting rooms. Portable Power Point projectors will be



used in the other two meeting rooms. Slide and transparency projectors are also available. Many of the oral presentations were sent to Randy Sterling prior to the meeting to facilitate the running of each scientific session

- The AJAS scientific sessions have been scheduled for rooms primarily on the second floor in Wallace Hall. Slide and transparency projectors are available. Power Point projectors and computers are to be provided by participants, although we will have back-ups as needed. Other rooms are available if interviews are required.
- Gorgas Scholarship scientific and interview sessions will take place primarily on the fourth floor in Wallace Hall
- The vendor's exhibits will take place in Room 207 Bibb Graves Hall on Thursday and Friday. A number of participants have agreed to provide demonstrations and display items
- Poster presentations are scheduled for Friday afternoon on the second floor of Bibb Graves Hall
- The Symposium on Friday morning, March 29, is scheduled to take place in Bibb Graves Auditorium. The theme will be "Alabama's Geological History." Richard Thurn and Jim Lacefield have organized the Symposium with Lacefield and 3 members of the Geological Survey of Alabama as Symposium speakers
- AJAS student participants can pick from two separate activities that have been organized for the AJAS science activity on Friday afternoon. John McCall and Richard Buckner will take a group to one of the local creeks to examine West Alabama aquatic animal biodiversity. Richard Thurn and 3 of the Symposium speakers will take a group on a fossil hunt in several nearby areas. Vans are available for transportation and UWA students will assist in the above activities
- The annual banquet (separate fee) at 7:00pm on Friday, March 29, has been scheduled for the Livingston Community Civic Center. Al Schotz, Nature Conservatory, is the banquet speaker and the title of his presentation is "Alabama's Biodiversity." Banquet tickets will be needed to attend and several door prizes will be given away
- The Social event for the JAAS and Gorgas Scholarship participants has been scheduled after the banquet on Friday night, March 29, in the basement of the Student Union Building. Vans are available for shuttling from the banquet to the site and to their motel

2. **Finance** (Eugene Omasta) – the Board and Finance Committee have been meeting via email. The following written report was submitted: The account balances (1/1/01-12/31/01) ended with a surplus of \$732.09. However, this surplus must be compared to an \$11,280.96 deficit during the same period for the previous year (1/1/00-12/31/00), resulting in an average deficit of \$5,274.44 per year for the two year period. As explained in the Treasurer's report, the large difference between the deficit in 2000 and the surplus in 2001 was the receipt of \$4,023.89 from Samford University in 2001 (instead of 2000), and healthy dues payments in the 4<sup>th</sup> quarter of 2001. In spite of the net loss of \$10,548.87 over the past two years, the Alabama

Academy of Science continues to be in excellent financial condition with total assets of \$79,789.40 as of 2/28/02. The primary reason for the overall deficit the past two years is the net cost of the Journal. For the past two years, external support for the Journal averaged \$5,120 per year while the Academy's share of the publishing costs have averaged \$13,193 per year—an average deficit of \$8,073 per year. The overall average deficit of \$5,274.44 per year is less than this figure because of surpluses in other areas. To assist in balancing the budget, the Budget and Finance Committee makes 4 recommendations to increase revenues and/or reduce Journal expenses:

- Increase dues by \$5, which should increase revenues by approximately \$2,500 per year
- Institute an abstract fee of \$10 per non-student paper. This should raise \$1,000-1,500 in revenues per year
- EITHER  
Reduce the number of Journal issues from 4 to 3 per year and publish the abstract issue of the Journal in electronic format only. Auburn will do this at no cost. There may be a one-time cost for the purchase of software so that abstracts could be submitted online. The cost savings should be approximately \$2,600 per year  
OR  
Reduce the number of Journal issues from 4 to 3 per year, expand one of the issues to include the abstracts, and change the cover to a no picture format. The abstracts could still be published electronically and be available to members before and during the spring meeting. The cost savings should be approximately \$2,500 per year
- Seek ways to increase membership. 100 new members would raise \$2,300 per year at current dues rates

3. **Membership** (Mark Meade) – Current membership status: AAS total membership = 586, AAS dues paid (2002) = 325 (55% of total membership) Goals of the Committee for 2002-03: (1) assemble task force to update membership directory; task force would consist of BBB students at Chair's institution (JSU) and have as its specific goal to remove members no longer in Alabama and update addresses of those still in Alabama; and (2) consider change in dues structure to stimulate new membership drive, questions to address include. (a) why are dues so high for students? (typical dues for students in other societies are about \$10); (b) can AAS ensure meeting attendees have paid dues? (include dues with registration fee); (c) would a discount for full members encourage them to solicit new members? (offer \$25 for 1, \$40 for 2); (d) would a separate call for dues (other than AAS meeting announcement) ensure members would pay dues?
4. **Research** (Larry Boots, Paul Davison, Bruce Smith) – The responsibilities of the Research Committee include awarding Research Grants, Travel Grants and Research Paper/Poster Awards. The Academy has budgeted amounts of \$2,400, \$600, and \$550, respectively, for each of these categories. The Committee experienced more activity than usual, awarding 26 Travel Grants of \$20 each, and 2 for \$30 each. The latter from Auburn and Jacksonville State and traveled the furthest. Eleven Research Grants were awarded in the \$200 each. In addition, 24 students have applied to par-

participate in the Paper/Poster competition. These awards will be presented Friday at the banquet

5. **Long-Range Planning** (Ken Marion) – During the last several years, the Long-Range Planning Committee has pointed out the need to carefully monitor the financial status of the *JAAS* and encouraged the Academy to take steps to raise additional funds. During the last two years, we asked the Academy to consider raising both dues and meeting registration fees. The Long-Range Planning Committee fully endorses the range of actions now placed before the Board of Trustees and Executive Committee of the Academy by the Budget and Finance Committee. The implementation of some of these possible actions is necessary for the long-term financial well-being of the Academy. The Long-Range Planning Committee makes the following recommendations:
  - Initiate appropriate steps to alleviate financial deficiencies primarily associated with *JAAS*. Monitor closely over the next two years to ascertain their effectiveness
  - Continue to encourage the Place of Meeting Committee to seek centrally located sites on a reasonably regular basis in order to maximize annual meeting participation
  - Renew our efforts to increase membership. Gradually declining membership plays an important role in our financial status
  - Assuming the success of this year's joint meeting with the Alabama Imaging and Microscopy Society, continue to encourage their participation. Seek other possibilities for joint meetings. The Long-Range Planning Committee has encouraged the exploration of joint meetings with other societies for the last few years
  - Continue the Executive Committee dinner before the Fall meeting
6. **Auditing (Senior Academy)** (David Shedler) – No report
7. **Auditing (Junior Academy)** (Danice Costes) – No report
8. **Editorial Board and Associate Journal Editors** (Thane Wibbels, Larry Witt, William Osterhoff) – I am pleased to announce that the following institutions have supported the *JAAS* as benefactors: Samford University (\$500); AUM (\$400); JSU (\$250); UA (\$500); USA (\$500); UNA (\$100); BSC (\$100); UWA (\$500); Montevallo (\$250); TSU (\$250) = \$3,350. It was noted that UAB dropped its support of the *JAAS*, and that AU is also listed as a benefactor because of its significant annual contribution to our publishing costs
9. **Place and Date of Meetings** (Thomas Bilbo) – Plans for future meetings include:
  - Jacksonville State University; March 19-22, 2003; Frank Romano (Local Arrangements Chair)
  - University of Montevallo; March 17-20, 2004; Houston Byrd and Kay Watts (Local Arrangements Chairs)
10. **Newsletter/Electronic Media** (Richard Hudiburg) – I report the following activities: (1) updated the web pages for the Academy on the current server at UNA (<http://www2.una.edu/psychology/aas.htm>). These updates were to web pages for the officers, committees, and sections of the Academy; (2) completed a web page for the Alabama Academy of Science constitution

(<http://www2.una.edu/psychology/aasconstitution2001.htm>); (3) provided a link from the Academy web page to the University of West Alabama server for the Academy's 79<sup>th</sup> Annual Meeting information; (4) a domain name was registered for the Academy through [www.powweb.com](http://www.powweb.com) (<http://alabamaacademyofscience.org>). Web hosting services were established with [www.powweb.com](http://www.powweb.com). The cost of the web hosting is a very modest \$7.77 per month for a year's contract and \$15 to register the domain name for one year (total = \$108.24). email accounts (100) are available with this service. Additional features can be added to the web hosting site for a modest fee (e.g., Secure Server for credit card transactions); (5) reimbursement of initial costs incurred by me to establish web hosting services is requested by the Academy. A budget line should be added to the Academy budget for the annual cost of web hosting services; (6) the Academy web pages will be transferred to the web hosting server during the coming months. A redirect link will be placed on the UNA server once the new URL has been developed and tested; (7) discussed development of web-based abstracts submission and publication with Eugene Omasta. Item No. 5 (above) was moved, seconded and (with a \$30 budget line item for a secure server) passed.

11. **Public Relations** (Myra Smith) – No report

12. **Archives** (Troy Best) – No report

13. **Science and Public Policy** (Dail Mullins) – The Science and Public Policy Committee has been relatively inactive since last October. Only two items are perhaps worth mentioning:

- On November 8, 2001, the Alabama State Board of Education voted to continue to require that a statement referring to evolution as controversial be inserted in biology textbooks. Many had hoped the board might simply drop the idea of a disclaimer, given changes in the Alabama Course of Study-Science (ACOSS) since 1995. However, it voted instead to require a new insert consisting of four paragraphs from the Preface to the 2001 ACOSS. I emailed a copy of the article about the new insert from the November 9, 2001, *Birmingham News* to the National Center for Science Education, and they ran a brief article in *Reports of the National Center for Science Education* (May-August 2001);
- On January 24, 2002, I received an email message from Stephen Watts which included a forwarded message from a volunteer worker at the McWane Science Center who was upset about the fact that McWane Center officials had apparently censored (with small, strategically placed clippings of paper) a poster in the gift shop of an anatomically correct female. This individual asked that the AAS investigate. On behalf of the Science and Public Policy Committee, I offered to inquire about the matter myself, which I did on January 28, and filed my report with Dr. Watts on January 30, 2002. Because the censored material was in the gift shop, as opposed to a museum exhibit, it was decided that further "action" on the part of the committee was unnecessary.

14. **Gardner Award** (Prakash Sharma) – No report

15. **Carmichael Award** (Velma Richardson) – The article selected for the E. B. Carmichael Award this year is "Exclusive-PCR with Denaturing Gradient Gel Electrophoresis: A New Approach to Identify Novel Alleles" by Gana Zhou, Department of

Biology, and Xianglan Y. Hood, Department of Physical and Earth Sciences, Jacksonville State University. This article appears in the October, 2001 issue of *JAAS* 72(04):215-229. All papers appearing in the issues dated in the year 2001 were included in the judging

16. **Resolutions** (Priscilla Holland) – Be it resolved by the Executive Committee that the following script be employed at the appropriate time: (Presentations at the Annual Banquet) – Each year the Academy recognizes individuals who have served it in an exceptional manner.

- First and foremost we recognize Richard Holland, Interim President of the University of West Alabama, for graciously hosting the 79<sup>th</sup> Annual Meeting of the Alabama Academy of Sciences
- The Academy would also like to recognize Donald Salter, Chair, Local Arrangements Committee, for the many weeks of planning and hard work that enabled us to have this very successful meeting
- The Academy would like to recognize William J. Boardman for many years of service as chair of the Emmet B. Carmichael Award Committee
- The Academy would like to recognize Mary Thomaskutty for many years of service as Science Fair Coordinator
- The Academy would like to recognize William J. Barrett for his service as a member of the Board of Trustees for many years
- The Academy would also like to recognize Samuel Barker for many years of service as a member of the Board of Trustees, President of the Academy, recipient of the Wright A. Gardner Award, and Chair of many committees including the Finance Committee
- Lastly, the Academy thanks Roland Dute for his able leadership of the Academy as its president during the past year

Deaths: The Academy would like to take a moment to recognize the following members of the Academy whom it has lost through death over the past year: Leonard Lee Bennett, Jr.; John Albert Fincher; Richard Dudley Morin

17. **Nominating** (Anne Cusic) – The following list indicates the officers whose terms expire in 2002 but who have agreed to remain in their current positions: (1) Trustees (Wayne Finley, Ken Marion, Prakash Sharma, Walter Wilborn); (2) Treasurer (Larry Krannich); (3) Editor (Jim Bradley); (4) State Counselor, Junior Academy (B. J. Bateman). Following are the offices that require new nominees: (1) Second Vice-President (Dr. Ron Jenkins of Samford University has accepted the nomination); (2) Associate Counselor to the Junior Academy (I have been unable to contact Wanda Phillips. She has not responded to my letter. I requested Dr. Bateman to inquire if she would be interested in remaining in this position or if he knew of a nominee. I have not received a reply from him. Therefore, the Committee needs to determine a candidate for this position)
18. **Mason Scholarship** (Michael Moeller) – The Committee received no completed applications for the William H. Mason Fellowship this year. The committee chair does not have an explanation for this phenomenon. The Fellowship was advertised in exactly the same manner as in the previous six years and there were several requests for application forms. Last year we received five applications and in the Spring of 1999,

we received six applications. We believe this year is an anomaly and strongly recommend that the scholarship program be continued

19. **Gorgas Scholarship Program** (Ellen Buckner) – The Gorgas Scholarship Committee is pleased to report that the Alabama Science Talent Search continues to grow with 47 submissions from the state to the Intel National Science Talent Search. One of the entrants was named National Semifinalist and one National Finalist. The finals of the Gorgas Competition will be held Friday, March 29, in room 412 of Wallace Hall on the University of West Alabama campus. Finalists were named from eight high schools from across the state. The Committee would like to recognize the outstanding teacher-sponsors of these finalists. Their work in encouraging students to enter the competition is instrumental to both the success of the program and to the success of the students. These are as follows: Wanda Griffiths (Murphy High School); Debbie Anderson (Jefferson County International Baccalaureate); Wanda Phillips (Brooks High School, Killen); Vicki Farina (Brooks High School, Killen); Melonie Hanson (J. O. Johnson High School); Shannon Upton (Bradshaw High School, Florence); Sophia Clifford (Mountain Brook High School); Peggy Murray (Grissom High School, Huntsville); April Miller (Alabama School of Fine Arts, Birmingham). This year the Committee voted to waive the rule limiting awards to only students attending Alabama colleges and universities. Awards will be given this year to the student's choice of in-state or out-of-state institutions. Evaluation of this waiver will be done in the coming year. All 10 finalists, including the two national winners, plan to participate this year. This promises to encourage a tight competition for the Gorgas Awards. I would like to thank Dr. Don Salter for his excellent assistance in recruitment of judges from the University of West Alabama for this year's competition

**Old Business (D)** – None

**New Business (E)** – Jim Bradley would like the Academy (in a future meeting) to consider expanding the Science Education Section (VII) to include science ethics/philosophy and history. This was discussed briefly but no motion was made and no action taken.

**Adjournment (F)** – The meeting was adjourned at 9:37pm.

Respectfully submitted,

Dail W. Mullins, Jr.  
Secretary  
Alabama Academy of Science











## INSTRUCTIONS TO AUTHORS

*Editorial Policy:* Publication of the *Journal of the Alabama Academy of Science* is restricted to members. Membership application forms can be obtained from Dail W. Mullins, Jr., Honors Program, HOH 105, University of Alabama at Birmingham, 1530 3rd Avenue South, Birmingham, AL 35294-4450. Subject matter should address original research in one of the discipline sections of the Academy: Biological Sciences; Chemistry; Geology; Forestry, Geography, Conservation, and Planning; Physics and Mathematics; Industry and Economics, Science Education; Social Sciences; Health Sciences; Engineering and Computer Science; and Anthropology. Timely review articles of exceptional quality and general readership interest will also be considered. Invited articles dealing with Science Activities in Alabama are occasionally published. Book reviews of Alabama authors are also solicited. Submission of an article for publication implies that it has not been published previously and that it not currently being considered for publication elsewhere. Each manuscript will receive at least two simultaneous peer reviews.

*Submission:* Submit an original and two copies to the editor at anytime. Papers which are unreasonably long and verbose, such as uncut theses, will be returned. The title page should contain the author's name, affiliation, and address, including zip code. The editor may request that manuscripts be submitted on a diskette upon their revision or acceptance.

*Manuscripts:* Consult recent issues of the *Journal* for format. Double-space manuscripts throughout, allowing 1-inch margins. Number all pages. An abstract not exceeding 200 words will be published if the author so desires. Use heading and subdivisions where necessary for clarity. Common headings are: **Introduction** (including literature review), **Procedures** (or **Materials and Methods**), **Results**, **Discussion**, and **Literature Cited**. Other formats may be more appropriate for certain subject matter areas. Headings should be in all caps and centered on the typed page; sub-headings should be italicized (underlined) and placed at the margin. Avoid excessive use of footnotes. Do not use the number 1 for footnotes; begin with 2. Skip additional footnote numbers if one or more authors must have their present address footnoted.

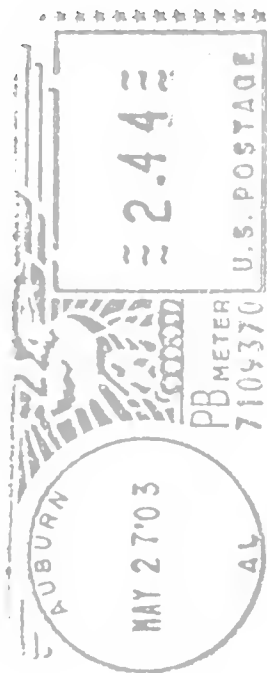
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